ARMY ORDNANCE

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Armament Research

Maj. Gen. G. M. Barnes

Universal Military Training

Edward N. Scheiberling

Rockets for War

Lieut. Col. L. U. Bailey

The New 155-mm. Howitzer

Brig. Gen. G. M. Wells

Our Tanks Are without Equal

An Editorial

A REVIEW OF INDUSTRIAL PREPAREDNESS FOR NATIONAL DEFENSE
PUBLISHED BY THE ARMY ORDNANCE ASSOCIATION, WASHINGTON, D. C.

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ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

Founded 1920

For Victory through Armament Research, Production, and Supply

CONTENTS

Tokyo Express . . . . . Frontispiece
Armament Research 221
MAJ. GEN. G. M. BARNES
The New 155-mm. Howitzer 223
BRIG. GEN. G. M. WELLS
Combat Preparedness 226
EDWARD N. SCHEIBERLING
Pearl Harbor to the Philippines . . . 228
MAJ. HOFFMAN NICKERSON
The Industry-Ordnance Team 232
Rockets for War 233
LIEUT. COL. L. U. BAILEY
The German Stratosphere Rocket, V2 . 236
Ammunition Production 237
COL. T. C. GERBER
Ships of the Army . . . (Pictorial) 241
The Age of Steam 249
MAJ. GEN. J. F. C. FULLER
Labram and the "Long Cecil" 258
COL. CLARENCE E. DAVIES
Ordnance Roll of Honor 260
New Firepower for Britain . (Pictorial) 262
Month by Month 263
Our Tanks Are without Equal 265
AN EDITORIAL
Association Affairs 266
Ordnance in Review 270
From the Record 272
New Developments 273
Automotive Maintenance 277
Professional Digest 278
Book Reviews 282
Index of Advertisements 319

The Army Ordnance Association is now more than 40,000 strong and its membership is growing fast. There are twenty-six local chapters with at least four more on the horizon. We are now organizing national divisions of the Association as outlined fully on page 232 and in the chart which accompanies that story.

The Ordnance cohorts are on the march —determined to win this war on all fronts with superior weapons for our forces and determined likewise to maintain the peace —with adequate military and industrial strength.

The Association is not a pressure group, it maintains no lobby for the passage of legislation, and represents no commercial or political body. It is devoted solely to an adequate understanding on the part of *all our people* of the necessity for Ordnance design, production, and supply in war and a general understanding thereof in peace.

Untold opportunities await the Association in organizing its strength in the days ahead. The responsibilities are equally great. Every member will perform an outstanding service to his country by making certain that his fellow citizens are thoroughly and constantly aware that victory and peace depend upon our guns as well as our men and that when the war is over we must keep our powder dry.

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"I hear the war's practically over... back home!"

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Signal Corps

Tokyo Express

Armament Research

Science and Industry Meet the Changing Demands of War

Maj. Gen. G. M. Barnes

WE of Ordnance have always been keenly aware that the most effective safeguards of the United States in war are the great reservoir of man power, the scientific and engineering talent, and the strong industrial system of our country. The Ordnance Department always has fostered and maintained a close working relationship with science and industry. During this emergency, the average citizen was surprised to find that this relationship had been at work for many years and that a background had already been laid for the teamwork which followed.

Metallurgical progress in this country has been for many years strongly influenced by the requirements of Ordnance for superior qualities in metals. Requirements of strength contributed to stronger cast iron for cannon in Civil War days, and later, when Ordnance engineers called for still stronger metals, especially steels, these were obtained through new melting practices, improved forging techniques, and the introduction of alloys to obtain higher physical properties.

Under the peacetime program, many developments important to this war had been achieved prior to 1940. Among these might be mentioned centrifugal casting of cannon which helped in the rapid production of artillery; the substitution of molybdenum for tungsten in high-speed tools; the cold-working method for making cannon with improved strength, permitting lighter weight guns and higher muzzle velocities; the development of testing techniques, such as macroetching, radiography, and impact, which contributed to improved quality and safety of performance. These and many more have been developments in which Ordnance has been associated with industry.

Metals and explosives designed to give the maximum destructive effect at the target are major factors in determining the final outcome of wars. The development and production of the unheard-of quantities of propellants and high explosives required in this war is an important story in itself. Under this great program our country furnished propellants and explosives for our own Army and at the same time met the critical shortages of our allies.

Modern warfare is such that a nation without a great metals industry and manufacturing capacity cannot successfully engage in combat. The strength of a nation in war can be gauged by its steel- and metal-producing capacities. The steel capacity of this country today is more than 94,000,000 tons annually which, with the Russian and British capacities, totals 136,000,000 tons.

Opposed to this, Germany and Japan, at their peaks, had approximately 67,000,000 tons. In the field of aluminum, United Nations' capacity is more than three times that available to Germany and Japan. In magnesium, we are also supreme. Our Nation's magnesium production alone is more than five times the total amount now available to our enemies. Of the world output of copper, 88 per cent is available to the United Nations, and only 6½ per cent is under German control.

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This favorable position in regard to essential and critical metals, however, did not prevent us from having serious metal shortages under our vast schedules of war matériel as required at home and abroad. For a time, many of these shortages seriously threatened the success of our program. It was necessary, in the midst of the great task of industrial mobilization, to take time to develop new methods and substitutes.

FOR example, in Ordnance the shortage of aluminum which went under first priority to aircraft, caused great difficulty. It was necessary to remove much of the aluminum used in the construction of tanks, substituting other metals for such components as transmission cases, engine parts, ammunition racks, and gun parts. In some cases it was found that by more careful engineering the substituted metals resulted in increased performance. In other cases, a return to the use of the critical metal was instituted as soon as the shortage disappeared.

In all our programs for the substitution of less critical materials, the policy of accepting no decrease in the performance of safety of the end product was maintained. There are many examples which might be used to illustrate advantages of these conservation activities to the Ordnance program and the war effort as a whole. Science and industry bore the main burden of much of this work. The National Academy of Sciences played a vital rôle. Especially significant was the work of the Metals and Minerals Advisory Committee which was organized early in the emergency and contributed to the conservation of materials. Great strides were made in solving the problems encountered in production and in overcoming shortages.

The steel industry converted its continuous strip mills to the rolling of ship plate, and in no other known way could sufficient plate have been produced to meet the abnormal demand of the Navy and the Maritime Commission. Much of the regular plate-mill capacity was being utilized in rolling armor plate and structural plate

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General Barnes is chief of the Research and Development Service of the Ordnance Department, U. S. Army. This is an address delivered by General Barnes before the National Academy of Sciences, Washington, D. C.

for the manufacture of tanks, gun mounts, and other items.

The demands for rolled armor plate for tank production could not be met, and a program for the development and manufacture of cast-steel armor on a great scale was inaugurated. Starting with practically no knowledge in this country concerning the manufacture of cast armor, American foundries pooled their efforts and quickly developed the necessary know-how.

Prior to the war, the metallurgy of armor and armor-piercing shot was very much of a mystery, and the few commercial companies engaged in such peacetime manufacture held their processes secret. In the beginning of the emergency, all manufacturers shared this secret information to make the mass manufacture of these products possible by plants scattered throughout the country.

This came about largely through the activities of the Ferrous Metallurgical Advisory Board. In 1939 and 1940 the activities of this board were greatly extended with the formation of subcommittees whose interests related to specific phases of Ordnance, such as guns, projectiles, armor—both rolled and cast—and welding of armor, and whose membership included producers and users, both American and allied, of the products concerned. Practically the entire steel producing and fabricating capacity of this country was represented in these subcommittees. Through them technical problems were discussed and solved and the information disseminated to the benefit of the entire industry.

While the work of instructing new manufacturers in the necessary techniques of armor and armor-piercing shot production was still in progress, the shortage of alloys became critical, and it was necessary to make drastic changes immediately. The alloy content was reduced to one-quarter or less, but the same policy was maintained of permitting no reduction in ballistic performance. Boron-treated steels were used in some of these items, and work is still progressing toward the wider use of boron in steels for other purposes.

Prior to the war, Swedish steels were used almost exclusively for highly stressed springs, such as those used in automatic guns and artillery. The loss of this steel importation created a serious situation, but typical of other problems so successfully solved, we are now producing spring steels which markedly exceed the best quality hitherto obtainable. Another outstanding accomplishment during this period was the rolling of gun barrels on seamless tubing mills. Gun tubes up to and including 75 mm. were so processed.

There are so many outstanding developments of science and industry in this war that it would not be possible to review these contributions adequately here. Since science must always look toward the future, it might not be amiss to examine a few of the problems which lie ahead of us in this field. For the future defense of our Nation a sound economic position is essential—economic in the sense that raw materials and processing, fabricating, and industrial procedures are such that the Nation is able to face an immediate emergency.

Science and industry must diligently and continuously lend their efforts toward the protection of our country. The National Academy of Sciences has performed this function since its creation by Abraham Lincoln. Today the academy and the National Research Council are coöperating effectively in solving problems which face the military. Many such problems and many new ones will face us at the conclusion of the war. It is urged that the academy aggressively and continuously study metals and minerals to insure that their availability to meet future war needs is adequate at all times. For example, there are great quantities of low-grade ores of manganese, chromium, and practically every other essential mineral within the continental limits of our country. But these ores are not suitable for present-day recovery and processing methods, and continuous work in perfecting satisfactory techniques must be pursued. Such an accomplishment would form a major contribution toward national independence and security.

Attention also may appropriately be given to the utilization of such available minerals as boron, tellurium, and other possible alloying elements as potential substitutes for present-day alloys. The introduction of jet propulsion into war matériel creates an additional need for steels to withstand abnormally elevated temperatures. The alloys now available are costly, difficult to produce, and may not be available in sufficient quantities should this development become a major factor in warfare.

There has been a great deal of comment on the advantages of stock-piling strategic minerals or metals. There are a number of such strategic materials that warrant careful consideration, and it is possible that stock piles should be maintained during the coming peace years.

There will be great demands for increased performance of materials, for as soon as peace is restored today's weapons are obsolescent. To depend upon them would be to court disaster. France made little progress in ordnance after World War I. She tried to oppose the Germans with weapons constructed from 1914 to 1918, thus contributing to her own defeat. The trend in weapons will be toward more firepower, higher velocities, longer ranges, and greater destruction. Mass production has emphasized the need of continual improvement in processes of manufacture, as illustrated by welding, stamping, die-casting, and similar methods.

The 75-mm. gun of World War I weighed 1,015 pounds, as compared with the 410 pounds of the 75-mm. gun of today—a direct measure of improved metallurgy. Greater mobility will require less weight, so that we must drain every safe ounce of strength from our armament.

This war has again demonstrated the importance of research and development. The Ordnance Department, from experience in two world wars, knows that the partnership method of research and development is the best policy. As other agencies are disbanded with the termination of war, we shall look more and more to the National Academy of Sciences for help in carrying the burden of peacetime research and development. Of no small importance is the matter of securing adequate funds. National security in years to come will be in direct ratio to the time, energy, and money we allot to armament research and development. This armament research now and in peace can best be accomplished by joint Ordnance programs in which the scientific and industrial establishments of our country continuously participate.

The New 155-mm. Howitzer

Signal Corps

Recent developments make this powerful mobile modern piece our most versatile field-artillery weapon

Brig. Gen. G. M. Wells

EXPERIENCE in World War II has demonstrated the outstanding importance of firepower as a means for attaining military success with minimum losses of personnel. The weapons for achieving firepower are many, ranging from the semiautomatic rifle and carbine to the latest types of bombing aircraft of long range and high bomb-load capacity. Each of these weapons has been designed to deliver metal and explosives on enemy troops and installations with the highest possible degree of efficiency in its particular field. Strong evidence of the effectiveness of our firepower is found in the comparative reports of enemy casualties and our own. All reports seem to indicate that, while pursuing the offensive under the most difficult conditions, our losses have consistently been less than those of the enemy. All previous concepts of offensive warfare have assumed that the contrary would be true.

Modern artillery provides one of the most effective means for achieving firepower in overwhelming volume. Many recent reports from our theater commanders give convincing proof of this fact. Growing out of actual battle experience in all theaters, the demands for more artillery and artillery ammunition have steadily increased. Whether the operation be a landing on a hostile shore or an attack against a strongly fortified line, the key to success has proved to be artillery fire in volume.

Artillery comprises a great variety of weapons, each one designed to meet a specific tactical need. There are several broad subdivisions of these weapons, including aircraft, antiaircraft, tank and antitank, infantry, and field-artillery purposes. The infantry and field-artillery types play the dominant artillery rôle in mobile land warfare and expend the great bulk of the artillery ammunition. The most important members of the mobile field-weapon group are the 105-mm. howitzer, designed to furnish close-in support of the doughboys; the 155-mm. howitzer, of which more will be said later; the 155-mm. "Long Tom" and 8-inch howitzer used for long-range counterbattery, destruction of bridges, fortifications, etc.; and the 8-inch gun and 240-mm. howitzer used for special missions where maximum range and destructive effect are necessary. While it is difficult to say that any one weapon in this group is more important than any other, the 155-mm. howitzer is undoubtedly the most versatile.

HOWITZERS of about 155-mm. or 6-inch caliber have long been an important part of the artillery equipment of all nations. At the close of World War I, United States Army artillery included two models of the French 155-mm. field howitzer (Schneider). These were a 1917 model of French manufacture

General Wells is chief of the Artillery Division, Industrial Service, Office of the Chief of Ordnance.

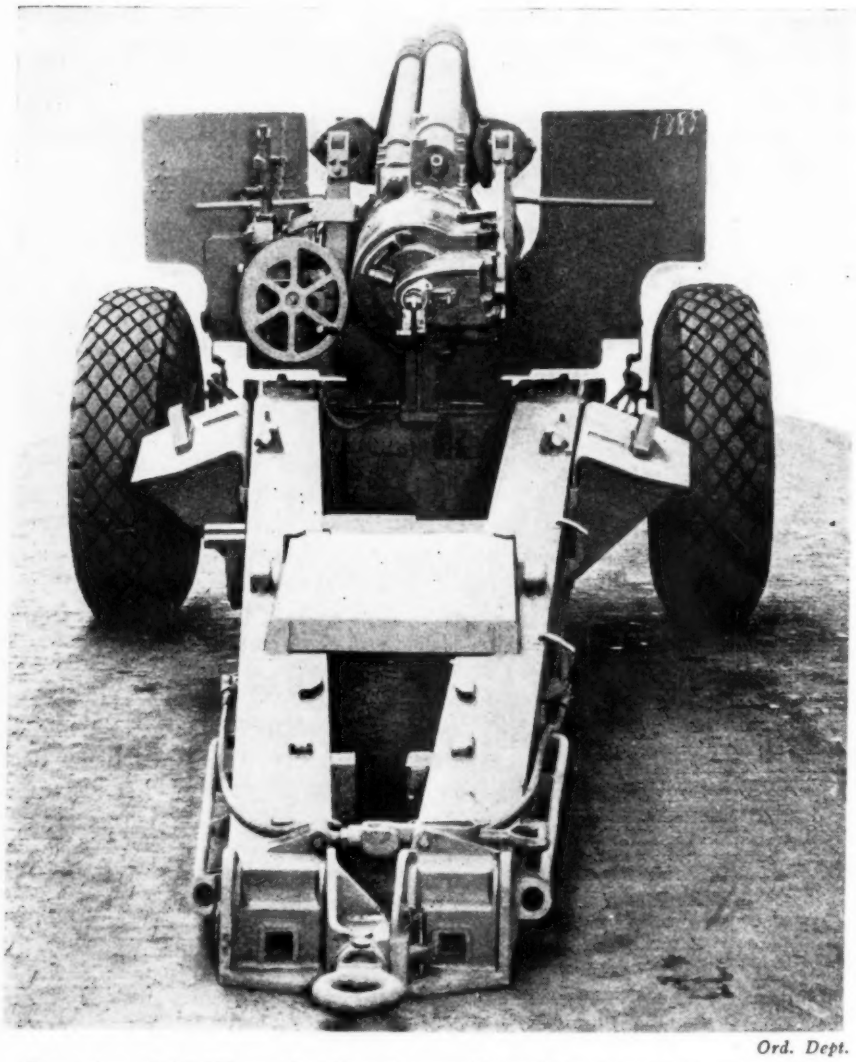
and a 1918 model of American manufacture based on the French design. In the opinion of all Allied belligerents, the 155-mm. howitzer had proved itself to be one of the outstanding weapons of the war. It was natural, therefore, that it should be retained as to type and that future developments should be directed toward increasing its range and general utility. A long period of development ensued which culminated in the U. S. 155-mm. howitzer M1.

THE new 155-mm. howitzer is superior to the World War I type in many important respects. It still fires a projectile weighing approximately ninety-five pounds, but the form of the projectile has been improved ballistically. This change in form, together with other ballistic improvements, has increased the accuracy at all ranges. The maximum range of the new howitzer is approximately 9½ miles or about one-third greater than the earlier types. The corresponding German and Japanese howitzers are outranged by substantial margins. The combination of consistent accuracy, a wide spread in effective ranges, and the heavy projectile help to explain the versatility of this weapon. It is equally effective for medium-range counterbattery, demolition of fortifications, or close-in support of the infantry. It is interesting to note that the last-mentioned usage was not seriously considered in designing the weapon. Recent developments in fuzes have made it possible to burst the projectile consistently at short distances above ground, and the effect of such bursts on enemy personnel is devastating. Extensive use of this howitzer for barrage fire followed in logical sequence.

Several characteristics other than range and accuracy contribute to the general utility of a field-artillery weapon. Provision for wide traverse of the gun with respect to the carriage is particularly desirable in order to permit firing on as many targets as possible with a minimum of delay. The new howitzer has a split trail, permitting forty-nine degrees' traverse as compared with the single trail on the World War I type with only six degrees' traverse.

The elevation has been increased from forty-two to sixty-five degrees to clear obstacles and to secure the maximum advantage from plunging fire on the relatively soft overhead covering of dugouts, pillboxes, and bunkers. Stability has been improved by use of a variable type of hydropneumatic recoil mechanism which permits longer recoil and more gradual absorption of firing stresses at the lower angles of elevation. A new type of firing mechanism has been perfected recently which will add much to the convenience and reliability of operation.

All truly modern weapons must be characterized by a high degree of mobility. Firepower and mobility must go hand in hand—the first making the break-through possible and the second permitting the rapid exploitation of this advantage. The Battle of France has provided a classic illustration of these principles: The German lines at Avranches were softened by the concentrated pounding of artillery; the infantry and tanks cleared a gap; and then all arms plunged through to outflank and encircle the enemy forces. An operation of this sort would have been impossible in World War I, due to the relatively limited mobility of the weapons then employed.



Ord. Dept.

Rear view of the 155-mm. howitzer in traveling position showing the split trails.

THE new 155-mm. howitzer was designed for high-speed transport both on highways and across country. The gun, recoil mechanism, and carriage are locked together for traveling as one integral unit and transported as a semitrailed load behind a high-speed prime mover. The large pneumatic tires and air brakes with which the gun carriage is equipped provide flotation and control for any kind of smooth or rough going. It is not generally understood that the stresses imposed on a gun carriage by firing are much less severe than those resulting from travel at high speed over rough terrain. The new 155-mm. howitzer carriage was designed to withstand the latter kind of treatment. The final design was the outgrowth of a long period of development during which several models were built and tested to destruction at the

Aberdeen Proving Ground. As a result, we now have a carriage which is giving trouble-free service in the many active theaters of operation.

The fire-control instruments used with a mobile gun carriage must be simple, rugged, and sufficiently accurate to permit laying on pin-point targets. The answer to these requirements has been found in a new panoramic telescope markedly superior to its predecessor types used in World War I. The telescope is carried in a mount of the so-called compensating type which corrects the line of fire automatically for cant of the gun carriage on rough ground. This mount was conceived and developed by one of our Ordnance engineers who has spent a lifetime in the fire-control business.

Another novel feature of the fire-control system is a device for lighting the scales and reticle of the telescope for night firing. The light source is a tiny bulb operated from a small dry-cell battery. The light is "piped" from the bulb to the several points requiring illumination by means of transparent rods made of a plastic material which will bend light rays around a corner. This arrangement delivers just enough light to provide illumination and no more. The illuminated scales are invisible a few feet from the battery and cannot be picked up by enemy observation.

PRIME CONTRACTORS AND GOVERNMENT ARSENALS WHICH HAVE CONTRIBUTED TO THE 155-MM. HOWITZER PRODUCTION PROGRAM

Carriage: **Link Belt Ordnance Co., Chicago, Ill.; York Safe and Lock Co., York, Pa.; Lufkin Foundry & Machine Co., Lufkin, Tex.; Rock Island Arsenal, Rock Island, Ill.; Western Austin Co., Aurora, Ill.; Caterpillar Tractor Co., Peoria, Ill.**

Howitzer: **Watervliet Arsenal, Watervliet, N. Y.; Yuba Manufacturing Co., Benicia, Calif.**

Recoil Mechanism: **Rock Island Arsenal; R. Hoe & Co., New York, N. Y.**

Fire Control: **Permutit Co., Brooklyn, N. Y.; Eastman Kodak Co., Rochester, N. Y.; Premier Stove Co., Belleville, Ill.; American Instrument Co., Silver Spring, Md.; Liberty Tool & Gage Co., Providence, R. I.; Mines Equipment Co., St. Louis, Mo.**

Ord. Dept.

The 155-mm. howitzer in firing position at zero degrees elevation.

The industry members of the Army Ordnance Association will perhaps be interested in a brief description of the structural characteristics of this howitzer and the manufacturing problems presented by its major components. There are four types of components—the cannon, the recoil mechanism, the carriage, and the fire-control instruments. Each requires its own special manufacturing technique which may or may not have a close counterpart in commercial industry. The gun carriage is a heavy welded structure which corresponds rather closely to modern railroad or construction equipment, except that tolerances are held much closer.

THE recoil mechanism is similar in some respects to the hydraulic devices which propel certain types of elevators. The telescopic sighting equipment can be produced by companies specializing in high-grade microscopes or other instruments of high precision. The cannon is quite different from any commercial item but can be made fairly easily by companies experienced in the machining of very heavy forgings. The tolerances on many parts of these mechanisms are necessarily held to very close limits in order to provide satisfactory accuracy of fire and interchangeability of replacement parts. Rather elaborate tooling is required for such parts, but this has often proved to be a blessing in disguise due to a corresponding reduction in assembly problems.

Production of the howitzer got under way late in 1942, on the basis of rather modest requirements existing at that time. The requirements have since been successively increased as more uses were found for this weapon. Deliveries to troops have now attained very substantial proportions and many hundreds of howitzers have received the acid test of battle usage. The reports received from the theaters on the performance of this weapon have been uniformly favorable. The following quotations are typical of such reports:

"Of particular interest was the work of the 155-mm. howitzer M1 in artillery barrage work. They worked over the Jap bivouac areas and gun positions in good shape."

"In commenting upon the fire efficiency of the 155-mm. howitzer M1, Colonel ——— submitted that the piece has been extremely rugged, effective, and accurate during the campaigns."

"The 155-mm. howitzer gave excellent results. It is invaluable for reënforcing direct-support battalion fires and interdicting rear areas."

"The 155-mm. howitzer proved most valuable and effective in operations at New Georgia and Bougainville."

"A 155-mm. howitzer was allotted (target—German observation post across Volturno Valley), a bracket of twenty-five yards was obtained, and three rounds were fired for effect using delay fuze. The second round in fire for effect was a direct hit and observation post and contents were plainly seen to be blown high into the air—'End of mission; end of dugout.'"

EDITOR'S NOTE.—Maj. Gen. C. T. Harris, Jr., writing in the January-February 1945 issue of ARMY ORDNANCE, said: "Our present ordnance is superior to that of our enemy, but it would be fatal if we remained satisfied with what we have. We must make absolutely sure that continuing development and research will keep it always ahead."

Signal Corps

Combat Preparedness

The American Legion's Plan for Universal Peacetime Military Training

Edward N. Scheiberling

INCREASED firepower, mobility, range, and destructive ability of modern weapons have made dangerous and obsolete the theory that the United States can complete its preparations for war under the fire of the enemy. Twice within the past quarter-century our country has been forced into wars which it did not wish, which it sought to avoid, and which it was not prepared to wage. Twice, through the fortitude and armed strength of allied nations, the United States has been able to forge great striking forces for land, sea, and air war, and to equip them for victory with the finest products of the American industrial machine.

No prudent American can hope that similar good fortune will be our lot if we should again face war with no greater strength ready for immediate action than we had in 1917 and 1939. If America faces another world war, this country will be the first and not the last target of the enemy aggressor. It is plain to students of military history that the fatal mistake Germany made twice, and Japan once, was that they permitted the Americans time to mobilize and arm with the strength that determined the issue of the conflict.

Since the end of World War I, the American Legion has recognized the danger in which an unprepared nation stood in a world that included discontented, envious, and war-loving peoples. Since 1919, the Legion has urged the Nation to profit by its past mistakes through the creation of a system of universal military training.

The organization is composed entirely of men who have been through at least one war; some through two. They know war, and they abhor it as an instrument for the settlement of international disagreements, but they also recognize that human nature still includes all the emotions which lead to conflict among individuals and among nations. They realize that embargo acts, neutrality acts, pious resolutions, and lip service to peace have not kept our Nation from being involved in wars that it neither fomented nor even wished. In a word, the American Legion has realized that the only answer to force is force—a strength sufficient to command the respect of the aggressor-minded.

Organization of a large professional standing army has been repugnant to Americans since the inception of the Republic, and the American Legion believes it will continue to be, both on the grounds of cost and of political implications. Universal military training, on the other hand, has been accepted by the Nation under the Conscription Act during the Civil War and under the Selective Service Acts of 1917 and 1940. The latter was voted while the Nation was still at peace, although under the shadow of a global conflict, and through that departure from its peacetime tradition the United States had nearly 1,000,000 men in advanced stages of Army training when the Japanese struck at Pearl Harbor.

Without that nucleus of a trained army, it is beyond debate or doubt that our country could not have moved to stem the Japanese advances in 1942 and that we could not have landed in Africa in the same year the forces that helped to clear the Mediterranean and eventually moved to the invasion of Germany.

Universal military training had to start from scratch in peacetime 1940. Much of the year had to be spent in assembling the fundamental bases of training, without the powerful stimulus that war furnished after December 7, 1941. It did allow time for the necessary groundwork and for the physical and spiritual conditioning of men to whom military life had been a remote concept.

I BELIEVE that the lesson from this experience is inescapable. In 1918, fourteen months elapsed before our soldiers engaged in noteworthy strength in the battles on French soil. In 1942, with the benefit of a year's peacetime military training, we were able to tackle the Japanese solidly nine months after war started and to put millions of well-trained men in striking distance of the Germans and the Italians.

If the universal military training system advocated by the American Legion since 1919 had been made effective before 1940, so that it would have been functioning perfectly when we went to war, the lapse between the opening blow and our forceful response might well have been measured in days rather than months, with a corresponding reduction in the toll of lives and treasure. And it might indeed have happened that the dictator nations would not have embarked on their ruthless courses in the face of a United States armed to

Mr. Scheiberling is national commander of the American Legion.

strike, if necessary, an immediate blow in the defense of human liberties.

The American Legion plan has varied in detail, but not in basic principle, since it was first organized in 1919. Its latest expression was formulated at its twenty-sixth national convention, meeting in Chicago in September 1944, in the following resolution:

"Whereas, the American Legion, believing the only effective basis of a sound and continuing national military and naval policy for a democratic form of government is the training of every able-bodied young man to defend his country, has, since its inception, advocated the adoption of a system of universal military training in the United States of America; now, therefore, be it

"Resolved, That the American Legion request the Congress immediately to enact legislation embodying the principle of universal military training, incorporating therein: (1) That every qualified young male American shall receive the advantage of twelve months of required military training, integrated with his academic education, and at an age least apt to disrupt his normal education and business life; (2) That for a reasonable period after his training he shall serve in a component as provided for in the National Defense Act of 1920 and prescribed by the Naval Department policy; and, be it further

"Resolved, That in order for the American people and the Congress to be better informed of the necessity and advantages of universal military training, the American Legion requests the Congress to invite a committee composed of representatives of academic education, the armed forces, and their civilian components, and such others as the Congress may desire, to meet immediately for the purpose of study and recommendation as to the application of the principles herein set forth."

THAT is a straightforward and thoroughly democratic procedure. It expresses the conviction of the American Legion that the right of citizenship in the United States carries with it the obligation of every able-bodied citizen to bear arms in his country's defense. This obligation has been recognized and declared by many of our national leaders, from George Washington to Theodore Roosevelt, but it has been given practical effect only under the iron stress of war and at an incalculable cost in life and money.

Signal Corps

Peacetime military training means proficiency in war.

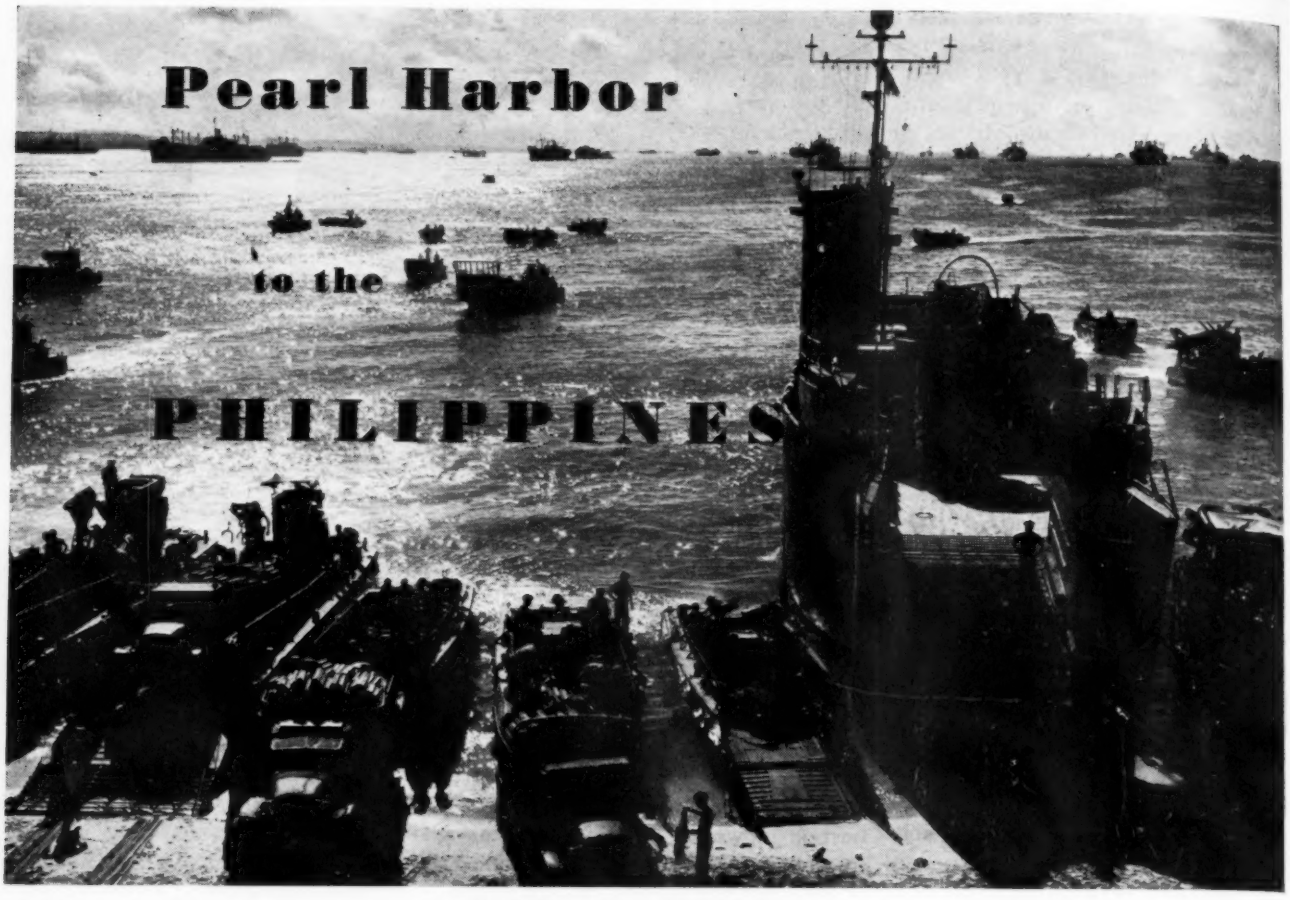
The resolution also seeks in the formulation of the program the counsel of all whose primary concern is with the production of worthy citizens. To realize its full possibilities for the country's well-being and to be a genuine force for the preservation of peace, a program of universal military training should be an integral part of the education of young men. If the annual classes approach their year of military training with the idea that it is something to be evaded or shuffled through in perfunctory fashion, the potential gains from the program will not be realized, and the Nation may be placed in actual peril by a false reliance on a scheme that possesses form but not substance.

If military training, on the other hand, is presented in the schools as a high and noble duty to the Nation, as a demonstration of citizenship at its best, the country will be the gainer through the services of approximately 1,000,000 young men each year—men trained both to command and obey, to wield and to respect authority, to appreciate the value of coöperation and teamwork, to value a healthy body and a healthy mind, and to know how to safeguard both. These gains to the Nation will be by-products of the training of men in the use of weapons and of military science, but they are none the less important for that reason. In fact, the purely military training may be the true by-product, for it will be used only if the Nation goes to war. It is the belief of the American Legion that the very existence of a strong trained reserve for our Army, Navy, and Air Forces, with a small but highly trained professional nucleus, will be a sovereign preventive of war involving the United States.

AS I interpret the mandates of the last three national conventions of the American Legion, we are in favor of an international association of free nations, the American delegates to which will have been clothed by Congress with power to speak and act for the United States instantly and effectively in any emergency which threatens to engulf the world in war again.

If the words of the American delegates are to carry weight consonant with the national dignity, it will be because prospective offenders against the international code will know that they mean what they say and that they will be supported by strong action. No other course can forestall aggression by international ruffians against weaker neighbors. We learned in China and Ethiopia that indignant words spoken by unarmed nations are contemptuously disregarded. We learned also that every incident of that kind encourages new raids by the believers in brute force against democracy and freedom.

The United States, now the arsenal of democracy, can become the citadel of peace, but only if we are prepared to guard the peace as realistically and as zealously as we fight our wars.



Maj. Hoffman Nickerson

FROM the entrance of the United States into the war on December 7, 1941, to November 1944, the war has had three phases: first, one of defense by the United Nations from December 1941 to November 1942; secondly, a turning of the tide followed by preliminary offensives against Germany from November 1942 to June 1944; thirdly, the opening of major offensives against both Germany and Japan from June 1944 to the present time.

The United States, in addition to its approach toward war with Germany as noted in the preceding article of this series (ARMY ORDNANCE, January-February, 1945), had also been pursuing an anti-Japanese economic policy. On December 7, 1941, without a declaration of war and while special Japanese envoys were discussing peace in Washington, airplanes from Japanese aircraft-carriers surprised and very seriously damaged the U. S. battle fleet in Pearl Harbor. At the same time, other Japanese airplanes caught the few U. S. Army planes in the Philippines on the ground and disabled most of them in a short time.

These strokes brought the U. S. and China into the global war on the British-Soviet side and Japan in on the German side, although Japan and Russia remained at peace. The new Asiatic ally of the European Axis possessed both land and sea power but was widely separated from its European partners. English sea power, now reënforced by American, was henceforward in partnership with two land masses, the U.S.S.R. and China, each in direct contact with one of the Axis partners and largely isolated both from the English-speaking countries and from each other. The United Nations now had the immense productivity of the U. S. safely behind its oceans and fully on their side. With time they could also count on formidable U. S. land reënforcement. On the other hand, the United States, like England, could act only across long and potentially vulnerable "bridges of ships" which offered a tempting target to Axis submarines.

For the moment, however, the Japanese promptly achieved vast southern conquests, including some of the richest sources of raw materials in the world. By March 1942 they were threatening Australia from northeastern New Guinea and the Solomon Islands. They had seized the great British base of Singapore and had occupied Burma, thus cutting the only Anglo-American land route to Free China. After crushing a tenacious but obviously doomed American and Filipino resistance on the Bataan Peninsula near Manila, the Mikado's men held all the intervening territory within the exterior points just mentioned. In northern Australia, with an exposed foothold in southeastern New Guinea, along the Burmese-Indian border, and in the Bay of Bengal, the United Nations stood on what seemed a doubtful defensive.

Major Nickerson until recently was on active duty with the Historical Section of the War Department General Staff. In World War I he served as a captain in the Ordnance Department and later with the General Staff, A.E.F. His writings on military and economic subjects are well known. A frequent contributor to the pages of this journal, he will publish shortly a volume entitled "Arms and Policy, 1939-1944."

This is the second and final installment of a series of two articles on World War II. The first, "From Poland to Pearl Harbor," appeared in the January-February 1945 issue of ARMY ORDNANCE (Vol. XXVIII, No. 148, p. 72).

This Japanese triumphal procession was due to greatly superior strength at nearly every point of contact both at sea, on land, and in the air, plus admirable coöperation between the various Japanese forces and a high average of personal courage and hardihood. After the first successful strokes at U. S. battleships and planes, the chief single incident was the sinking of two British capital ships in Malayan waters by Japanese torpedo-carrying aircraft while those ships were trying to interfere with Japanese troop landings. On the political side, only in the Philippines did an appreciable part of the natives resist the invaders. Almost everywhere else the Japanese were passively accepted.

Throughout the succession of Japanese victories, the English-speaking allies maintained their joint decision to consider Germany as their chief enemy. Americans might have debated this, but, with the Germans on the French coast only twenty miles from Dover, no Englishman could. Vital though it was to keep the Japanese from India and Australia, the whole Japanese theater was, in the main, to receive only enough Anglo-American forces to halt the enemy and to occupy them with local counteroffensives. After all, the Japanese were now weakened by the enormous length of their lines of communication—to reach Burma from their home islands they must travel for more than 4,000 miles.

Meanwhile England—still under great strain and heavily threatened—was more vital than any point outside the Americas, even from a purely American point of view. It was a valuable defensive outpost, an advanced air-bombing base, and a necessary base for future land offensives. Thus it was worth far more than any point in the Western Pacific, the Indian Ocean, or the Mediterranean. The one theater of comparable importance was Russia where the bulk of the German Army, perhaps 200 out of 300 divisions, plus a mass of satellite troops, was engaged.

PARADOXICALLY enough, the first months of American belligerency were unfavorable to the United Nations, not only in the Japanese theater but also in the German, for Nazi submarines had considerable success in attacking shipping, especially oil tankers, just off the American coast. The U. S. Navy rightly concentrated its existing ships and trained crews on the primary tasks of keeping open the sea lanes to England and halting the Japanese, necessarily neglecting for a time the considerable annoyance along its own Atlantic shore.

In addition to this, the U. S. had to content itself with secondary activities while building up its strength both by land and sea. It reënforced the British bombing campaign against Germany—with what results observers are not yet agreed—and made intense efforts to supply the Russians both by way of the far north and across Iran. U. S. garrisons were—somewhat lavishly—furnished to a number of points as yet unoccupied by the Japanese in the Pacific. In the spring of 1942, a small force of U. S. Marines landed and maintained themselves on what had been Japanese-occupied territory in the island of Guadalcanal in the Solomons. Through the summer of 1942 a series of naval actions in the Pacific, on the whole, went against the Japanese, especially off Midway.

In the summer of 1942, the Germans in North Africa victoriously advanced close to Egypt. Also in southern Russia they pushed far forward, threatening the oil of the eastern Caucasus and reaching the Volga, the vital artery by which that oil reached central Russia at Stalingrad. On the other hand, they did not try to advance in the central or northern sectors. In other words, although the future was to show that they still had plenty of men, they were trying to do the job without sacrificing them.

In the autumn, however, the tide of war began to turn on land as it had already done at sea. With American air support the British had partly cut the trans-Mediterranean communications of the Axis forces in North Africa. In spite of the long haul around Africa, Anglo-American sea power had been accumulating resources for an offensive based on Egypt. The British now struck back at El Alamein, driving the local survivors of their enemies westward. Australian and American ground troops, vigorously supported from the air, began to push the Japanese back along the jungle trails of New Guinea. The German position around Stalingrad was already threatened when, early in November 1942, Anglo-American forces landed in North Africa in the first of a series of preliminary offensives destined to lead up to a major attack against the Germans in the West. Everywhere the Axis had lost the initiative.

TO anticipate events slightly, German difficulties at Stalingrad soon turned into a local disaster. An entire German field army was cut off and destroyed, its commander surrendering on February 1, 1943. Thereupon the German radio began a vigorous "gloom campaign" on the theme of the fatherland in danger. To this melancholy accompaniment German man power was, for the first time in this conflict, intensively mobilized.

This brings us to a mystery even darker than that underlying the German decision to attack the U.S.S.R. In that case it is at least clear that they must have been overconfident. For 1941, they admitted permanent losses of well over 850,000 and for 1942 of only just over 500,000. With the U. S. in the war, the German Government and High Command must have seen that time was running against them. They must also have seen that their best chance would be an intense effort to knock out the Russians before American power began to be felt. Why, then, in 1942 did they try to "win on the cheap"? After gambling so greatly, they failed to play their last card with vigor.

We now return to the Anglo-American decision to move into North Africa. This decision, which was destined to shape the war in the West throughout the phase of preliminary offensives, was dictated by sea power. It was not a blow at the heart of German strength, which the English-speaking countries could reach only in European France. The Russians had long been agitating for the establishment of just such a "second front," but for this the Anglo-American leaders did not yet consider themselves strong enough. The defeat of a landing in France would have benefited the Russians little.

On the contrary, the prime necessity

The United Nations' command in the Southwest Pacific worked out a mode of action built around the long-range land-based bomber and transport plane. It was not necessary to assault each far-flung Japanese garrison. The long-range plane permitted strategic penetration so deep as to change the entire position of the Japanese.

for sea powers is to strengthen their overseas communications, and this could best be done by opening the Mediterranean. Further, the Italo-German army in North Africa was a tempting target, since it was the only non-Japanese Axis force with overseas bases and therefore vulnerable communications. The same was true of any other Axis troops which might be landed in North Africa. Politically, a North African operation promised well because most Frenchmen dislike Germans and despise Italians.

This political element indeed demanded extremely bold and risky strategy. As everything depended on persuading the local French leaders to come over, it was necessary to land not only on the Atlantic coast of Morocco and at Oran in the Mediterranean, about 250 sea miles east of Gibraltar, but also at Algiers, another 200 miles further east and less than 500 miles from Axis air bases in Sicily. North Africa also meant subtracting warships and merchantmen from the Pacific where the Japanese were still extremely dangerous.

These risks, however, were taken, and the North African operation succeeded. The Axis strenuously reënforced eastern Tunisia and managed to hold out there until May 1943, but the Anglo-Americans won the battle of supply, and their comparatively green troops and staffs steadily improved under fire. An interesting technical point is that the final collapse of the Axis' North African forces was as sudden, complete, and almost as bloodless as the early German lightning victories—only 2,000 British casualties resulted, including wounded but excluding American losses. Thus the lesson was repeated that against an enemy who can be cornered, a force superior in planes and tanks can exploit success rapidly and to the limit.

MEANWHILE the U.S.S.R. vigorously followed up its victory at Stalingrad. In the first six months of 1943 the Russians ousted the Germans from about a third of the vast Soviet territories which the latter had occupied. In July the invaders launched a last attack in Russia, but only on a comparatively narrow front of about 200 miles. After a week of small gains they desisted, whereupon the Russians again went over to the offensive, and at the new year the invaders still held only about a quarter of the Soviet territory which they had occupied at such great cost.

Throughout 1943 the all-important war at sea went in favor of the English-speaking countries. Large maritime American building and training programs began to bear fruit. German submarines were being successfully hunted. The Japanese Navy was definitely on the defensive. Everywhere the Anglo-American "bridge of ships" was becoming stronger.

FACILITATED by these naval successes, throughout the twelve months beginning with May 1943, the English-speaking countries engaged in a series of amphibious operations in the Mediterranean. Over the political and strategic wisdom of at least some of these, future historians may debate at length. Here we may summarize without attempting judgment.

After the victory in North Africa, the Anglo-American forces there were well placed to attempt the conquest of Sicily, which indeed was desirable for the sake of their original object of opening the Mediterranean to United Nations' sea-borne traffic. A month, however, was devoted to air and naval bombardment of the tiny island of Pantelleria, where the Italian garrison surrendered as soon as the appearance of the first allied landing parties made it possible for them to do so. Next, Sicily was conquered at small cost in casualties.

At this point, however, it might be argued with some show of reason that the English and Americans might have paused in their Mediterranean activities, contenting themselves with taking Sardinia and Corsica. Instead they moved into the rugged and poverty-stricken southern Italy. There, after a considerable effort, employing far more men and matériel than was at the disposal of the Axis forces opposing them, they were only just about to enter Rome by June 1, 1944. In the meantime, the legitimate Italian government had first surrendered and had then joined the United Nations. On the other hand, the Germans still held the populous industrial northern Italy where a pro-German republic had been set up. In other words, Germany, with inferior numbers, had at least been able to buy time cheaply.

A novel technical expedient was used to strengthen the air cover of the Salerno landing, which was made outside the effective range of fighter planes based on the nearest allied land bases in Sicily. The fighter planes which supported the landing troops were flown off from aircraft-carrying ships which remained near enough to Sicily to be covered by other fighters based on that island.

Throughout the first five months of 1944, the German retreat in Russia continued. By the middle of March, the Soviet armies had advanced south of the Pinsk Marshes into Poland and were threatening the Axis' hold on Odessa. By the end of May they had retaken nearly all the territory of the prewar Soviet Union and had also entered northern Rumania.

On June 6, 1944, U. S. and British troops landed in France. U. S. land power, built up behind the shield of sea power, was now strong enough to warrant a major offensive in the West. Superiority not only at sea but also in the air was, of course, necessary. Thus the air battles fought over Axis and Axis-occupied territory for many months past were preliminaries to the invasion. Special types of landing craft, repeatedly tested in the Mediterranean, were now available in great numbers in the rougher water of the Channel. German mines had to be swept, and obstacles in the shallow water off the beaches had to be cleared.

SINCE Anglo-American air superiority would be most effective within range of land-based fighter planes which must fly either from England or from Corsica, the two possible invasion coasts were in the northwest and the extreme southeast of France. Although the great strength of England as a base indicated that the main blow must be struck from there, nevertheless, in pure map strategy to begin by making a strong diversion in southeastern France would have offered certain advantages. Even a moderate measure of success there would either have given the United Nations a considerable extent of territory at little cost, or would at least have attracted an appreciable part of the German reserves, thus weakening German resistance to the principal attack. For reasons not yet made public the Channel landing was made first, on June 6th.

Of the three peninsulas which jut out from the northwest coast of France, the central one, of which the principal town and port is Cherbourg, was chosen as the point of attack. The

Pas-de-Calais, immediately opposite the southeast corner of England, was the region from which the Germans were launching their new weapon, the robot bomb. Also the blunt shape of that peninsula would have made it difficult for the Germans to contain a successful landing there; the liberating troops would have had ample space in which to fan out.

On the other hand, the robot bomb could not be strategically decisive, and the Germans were locally stronger in the Pas-de-Calais than in any other threatened region, so that particularly heavy risks would have to be run there in the critical, early stage of the landing. Brittany was rejected, probably because attacks on its southern coast could not easily have been supported by land-based fighter planes.

The landings succeeded. A beachhead about forty miles wide was established with its western flank on the eastern side of the Cherbourg peninsula, and a steady advance was maintained in spite of determined German efforts to halt it. This epoch-making result was achieved first by admirable cooperation between air, sea, and land forces, secondly by what seems almost a miracle of supply. The axiom that improvements in weapons and instruments of transport and communication reduce the military value of geographical obstacles was never more convincingly illustrated.

U. S. Navy

America's naval air superiority now allows our carrier planes to operate within range of Japanese land-based aircraft.

AT first the advance was slow and almost wholly on the western flank. Cherbourg fell just over two weeks after the first landings. Only on August 2nd, nearly two months from those landings, did the allied right reach the base of the peninsula. Here, however, German resistance locally snapped. American mechanized and motorized forces promptly began to fan out. Instead of withdrawing, the German command tried to pinch off these advanced elements by a counterattack made from east to west. When that failed, there followed one of those rapid bounds characteristic of contemporary war. By September 2nd, Thionville, near the German border and about 350 miles eastward from the original breakthrough, had been reached—an average speed of more than 11 miles a day for 31 days.

Meanwhile, on August 15th, the long-delayed secondary allied landing had been made good in southeastern France. There the German resistance, although sometimes determined, was numerically weak, so that after advancing more than 300 miles northward in 28 days, contact was made on September 12th at Châtillon-sur-Seine with elements which had advanced eastward from the main landing. Except for stubborn but isolated German garrisons blocking most of the Atlantic ports, nearly all French territory was now free, together with most of Belgium. On the same day, September 12th, advance guards of the U. S. First Army, moving eastward from Belgium, crossed the German border near Aachen, better known as Aix-la-Chapelle. No matter how long and bloody the end of the European war might be, its last phase, the invasion of Germany, had begun.

On the Russian front north of the Pinsk Marshes during July 1944 the Germans retreated no less than 300 miles. By August 1st, about the time of the Anglo-American break-through in Normandy, Russian advance guards were close to the East Prussian frontier and to Warsaw. From that date, however, the Soviet effort was switched to the south, whether from choice or because of difficult communications is not known. In Eastern Europe the political gains were considerable; late in August, Rumania broke with Germany, while Finland and Bulgaria did so early in September.

In the first ten months of 1944 the United Nations also registered notable gains over vast distances of the Pacific. Most of the many islands of this theater almost wholly lack good overland communications. Thus, except in the Philippines, Java, and Sumatra, nearly all military movement, not only between islands but also between different points on the same island, must be by water or by air. In such archipelagoes air work dominates strategy even more than on the high seas or the continents.

Incidentally, recent American concern as to places like Greenland, Iceland, the "hump" of Brazil, etc., reflects the belief that in any major war in which the U. S. might be engaged without allies we might have to operate in theaters strategically somewhat like the Western Pacific.

THE United Nations' command in the Southwest Pacific worked out a mode of action built around the long-range land-based bomber and transport plane. It was not necessary to assault each far-flung Japanese garrison. The long-range plane permitted strategic penetration so deep as to change the entire Japanese position.

The common objective of both the Southwest Pacific Command and of the U. S. Pacific Fleet was the Philippine archipelago. Geographically its possession would almost wholly cut off the Japanese from their newly conquered Southern Empire. Politically the attempt would be favored by an appreciable amount of active Filipino operation. On October 20th, by-passing Mindanao in a long overseas jump, a considerable American force successfully landed on Leyte. Shortly afterward the naval escort defeated, with heavy Japanese loss, an attack by the greater part of the Japanese fleet, and early in January 1945 General MacArthur began the reconquest of Luzon by landing a force at Lingayen Gulf.

The Industry-Ordnance Team

THE strength of American arms in battle is the strength of the people and the factories that produce our weapons. When this war is won, the victory will be in tribute to many factors in our national life but to none more than to the strength of American industry—laborers, mechanics, foremen, top management, and owners. Our American economy and our American genius for getting things done have proved themselves beyond question in this war. Starting out as the arsenal of democracy, we have armed every one of our allies, as well as ourselves, with superior weapons in unheard-of quantities. Complete victory is bound to come. But what about our weapon preparedness in time of peace? We must not go wrong on that again!

¶ Facing this page is a diagrammatic outline of a type of teamwork to make sure that American industry stays strong for the production of weapons in any future war. There is presented for the first time a schematic analysis of Industry-Ordnance coöperation in time of peace. Briefly it provides for twelve industry divisions of the Army Ordnance Association in addition to the twenty-six local chapters now in existence. The sole idea of the industry divisions is to keep available as a nucleus the personnel now engaged in each particular type of armament operation so that in the years to come they will have a mutual bond of interest and readiness. For example, there has grown up in the United States within the past five years a powerful artillery industry. Its members are companies and individuals who in normal times produce heavy machinery. These companies and their personnel, when peace comes again, will revert speedily—we hope—to the production of normal peacetime goods. But the knowledge, skills, techniques, and social contacts of the personnel of these companies *as wartime artillery producers* are one of the strongest military assets of the United States. Our strength in guns will be in proportion to the continuing zeal of such personnel in time of peace.

¶ Multiply this artillery example by hundreds. The same reasoning applies for artillery ammunition and small-arms ammunition. It applies equally to the small-arms industry, the automotive industry, the machine-tool industry, and so on. With equal emphasis it applies in the fields of management, training, jurisprudence, and all other functional operations of our huge industrial-military machine. That relationship must continue so that the lessons of this war in all the ramified fields of ordnance operation are not lost to our country.

¶ Already several of the industry divisions outlined on the accompanying chart are being organized. It will not be long before committees are in operation for organizing all of them. Thereafter every member of the Army Ordnance Association—new as well as old—will be invited to select the industry division with which, by experience and status in military or civilian life, he is most familiar. Members of a division as such will hold meetings from time to time for the discussion of problems within the field of that division. They will visit industrial and Ordnance establishments as a group where activities are conducted of special interest in that field. They will issue reports, studies, and recommendations applying to particular ordnance problems. In other words, the industry divisions of the Army Ordnance Association, while carrying on their respective programs, will share also in the nationwide activities of the national Association. And, at the same time, every member of an industry division will also be a member of the local Post in whose territory he resides.

¶ Through this means it is the hope of the Army Ordnance Association that the Industry-Ordnance team will be kept strong as never before—strong for the growing demands of peace and the production of peacetime commodities for a better America; strong also for the growing demands of armament which in this age of robots, rockets, and radio must not falter for an instant.

Air Forces

Recent U. S. Developments Indicate that an Old Combat Weapon Is Back To Stay

Lieut. Col. L. U. Bailey

THE theory of rocket propulsion is not new. But the fuller exploitation of rockets for war is unquestionably a development of the present conflict. Numerous effective rocket weapons have evolved—rockets of various sizes, ranges, and destructive effect—that may be launched from planes, tanks, ships, landing craft, and various ground launchers.

Generally speaking, the rocket consists of two major units—the shell or head unit and the motor or propulsive unit. The shell unit carries the "pay load"—the high-explosive or chemical charge to be directed to the target—and also the fuze which controls the detonation or ignition of the charge. The shell unit is usually assembled to the forward part of the rocket.

Colonel Bailey is chief of the Weapons Projects Branch, Rocket Development Division, Office, Chief of Ordnance. He was assisted in the preparation of this article by Maj. H. G. Jones, Jr., who is chief of the large-caliber rocket section, Weapons Projects Branch, Rocket Development Division.

The motor or propulsive unit contains all the propellent and stabilizing components to carry the explosive charge to the target. The components include a charge of propellent powder adequately supported inside the motor tube, an igniter to ignite the propellant, a nozzle through which the exhaust gases are expelled to the rear, and a means for stabilizing the complete round during flight.

Ordnance plants throughout the United States are producing millions of rockets—evidence enough that the rocket has become a great new weapon of this war.

Closely following the "birth of the bazooka" came the development of larger size rockets. These were brought into being to meet a variety of range requirements from the using services. Rockets to simulate low-flying aircraft for target practice, rockets to be fired from fighter aircraft, rockets to be fired from the ground against personnel and strong defense positions, and rockets to carry smoke and incendiary mixtures were requested as the possibilities of rocket propulsion unfolded.

THE development of the 2.36-inch M6 bazooka rocket has been revealed to the readers of ARMY ORDNANCE in an article by Col. L. A. Skinner, Ord. Dept., which appeared in the September-October 1944 issue (Vol. XXVII, No. 146, p. 261). This weapon has now been used in all combat areas, and evidence of its destructive power against enemy positions and equipment may be found in the results of practically every major engagement. Armored cars, concrete pillboxes and tanks, even the German Tiger tank, have been knocked out easily when attacked by the bazooka. For instance, at Caen in the Normandy campaign the bazooka was credited with destroying seventeen of a concentration of thirty-five German tanks.

Improvements have been made in the original 2.36-inch rocket ammunition as well as in the launcher. The fins used to stabilize the flight of the rocket have been redesigned and changed to a ring type. The contour of the nose of the high-explosive shell has been changed after exhaustive experiments to improve

the penetration of the round. These changes, which have been in quantity production for some time as the 2.36-inch M6A3 rocket, have enabled this rocket to defeat the toughest and heaviest armored vehicles that the enemy has placed in the field.

A companion round to the high-explosive round has been issued to the Army Ground Forces. This rocket is known as the 2.36-inch M10 and carries a charge of white phosphorus smoke. The development of the smoke rocket was carried out with the able assistance and coöperation of the Chemical Warfare Service. The white phosphorus bazooka ammunition is fired from the same launchers and in the same manner as the M6A3 rocket. The characteristics of the round with respect to weight and velocity have been kept similar to those of the high-explosive model so that both rockets may be used interchangeably in the same launcher without changing sights or other equipment.

A larger size rocket, generally referred to as the "target rocket," came into being as a result of a requirement from the Antiaircraft Command. A fast-moving target, one that would have a speed of approximately 450 miles an hour, was needed to assist in the training of the personnel who operate the guns.

Three 4.5-in. M8A1 rockets fuzed for firing either from ground or aircraft launchers.

Signal Corps

The American bazooka can stop almost any armored enemy vehicle.

The 3.25-inch M2 target rocket was developed with the assistance of the National Bureau of Standards and the National Defense Research Committee and placed into production by Revere Copper and Brass, Inc. One problem encountered was the difficulty of obtaining a projectile with sufficient size to present an adequate target to the gunners and still be light enough in weight to have the necessary speed. The solution appeared in the use of three large fins made of plywood bonded with waterproof cement which, in addition to stabilizing the rocket, serve as the target while the rocket is in flight. A simple rail launcher on a light 2-wheel carriage was provided to launch the rocket. The launcher includes a level and quadrant for setting elevation and a pintle to permit towing by standard military vehicles.

It has been found that the M2 target rocket is a considerable improvement over the towed, sleeve-type antiaircraft target because, by properly placing the launchers, it is possible to direct the flight of the rockets to simulate practically all types of attack by low-flying aircraft. A recent improvement in this rocket is the adaptation of a flare to the front of the round. The purpose of the flare is to make the trajectory more visible both for day and night training practice. The flare is ignited by hot gases from the rocket chamber so that no separate firing circuit is required. The glow and smoke are visible throughout the flight at maximum range.

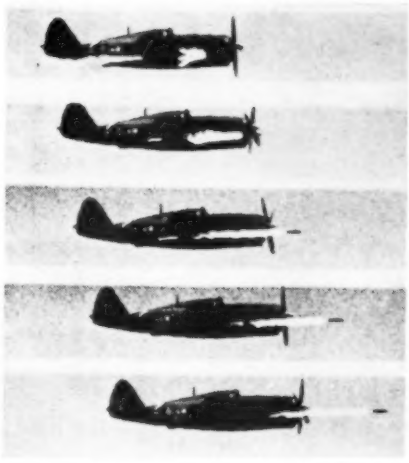
The target rocket is the simplest type that has been placed in production due to the fact that no high-explosive or other type of shell is required. The rocket motor forms the forward part of the projectile and the fins with the tube support form the rear section. The propellant for this rocket motor as well as for the other sizes of rockets described in this article is a solid fuel. This type of propellant requires less accessory equipment for ignition and control of release of energy than for other types, such as liquid fuels.

THE M8 series rockets are 4.5 inches in diameter throughout and contain a substantial charge of high explosive in a steel shell attached to the front end of the rocket motor. A detonating fuze is provided. Fins attached to the rocket motor to provide stability in flight complete the external components of the round.

This rocket, although fin-stabilized like a mortar shell and the other type rockets described, has fins of a completely different type. These fins are of the folding type; that is, in the closed position they do not extend beyond the diameter of the rocket body, but when in free flight the fin blades extend out into the air stream to guide the rocket straight on its course. The fins are free to pivot from the closed position into the extended position and when fully opened are held in that position. This construction was made to enable the rocket to be fired from a smooth-wall tube launcher. When fired from ground launchers, the M8 series rockets have a range of over 4,000 yards. They weigh

less than forty pounds each, can be easily handled by one man, and carry the punch of a 105-mm. shell.

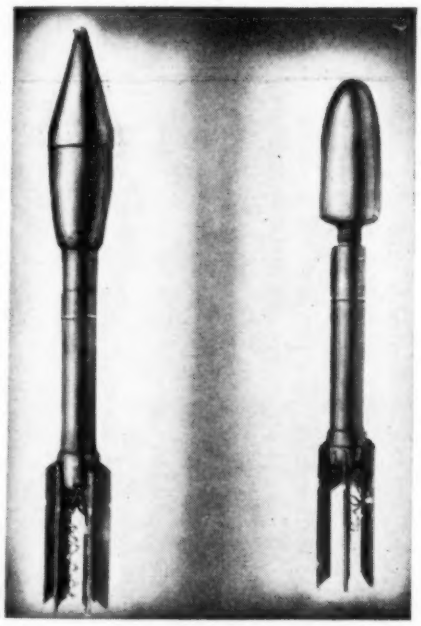
This rocket is fired electrically in single or multiple fire at the selection of the gunner. Contact is made with the ignition circuit through two metal rings on the closure at the back end of the motor in the older types. A new design rocket has a double-contact, single-prong plug attached to the rear end. The plug can be inserted in the jacks provided on the launchers. Any source of potential can be used to fire the rocket should the source provided fail to operate.



A sequence of photographs showing the firing of a rocket from the Republic P-47.

MANY reports have already been received from several theaters of operation giving account of combat experience using the 4.5-inch rocket. This versatile rocket can, without change, be used as a ground weapon and as a projectile to be fired from fighter aircraft. It has been dubbed the "flying bazooka" by correspondents in relating the destruction of enemy equipment and personnel. The name has stuck even though the round is larger in diameter and longer than the familiar 2.36-inch bazooka ammunition used by the infantry as an antitank weapon.

The chief advantage of rocket propulsion for projectiles to be fired from aircraft is in the absence of recoil. This feature allows pursuit planes such as the P-38, P-39, P-40, P-47, and P-51 to carry and to fire a number of heavy-caliber rockets on a single mission. Successful results have been obtained by rocket-equipped fighter aircraft against enemy bivouac areas, rail and highway bridges, ammunition dumps, locomotives, and other military targets. Combat usage has been reported as especially effective from the China-Burma-India and Pacific theaters.



Early models of the 2.36-in. high-explosive rocket (left) and smoke rocket (right).

The aircraft launchers developed for the M8-type rocket consist primarily of straight tubes made up in clusters of three for installation under each wing of the plane. For aircraft use the first consideration after that of strength and drag is that of weight. The use of steel tubes for other than proof testing was out of the question due to the excessive weight. Lightweight metals such as aluminum and magnesium were critically short during the period of early development. A solution was provided in a plastic tube developed by the General Electric Company in collaboration with the Ordnance Department. This tube was made from a special paper and impregnated with a plastic compound under controlled conditions. Clusters of plastic tubes successfully met tests required and were given the designation of "Launcher, Rocket, 3-tube, 4.5-inch, Aircraft, M10."

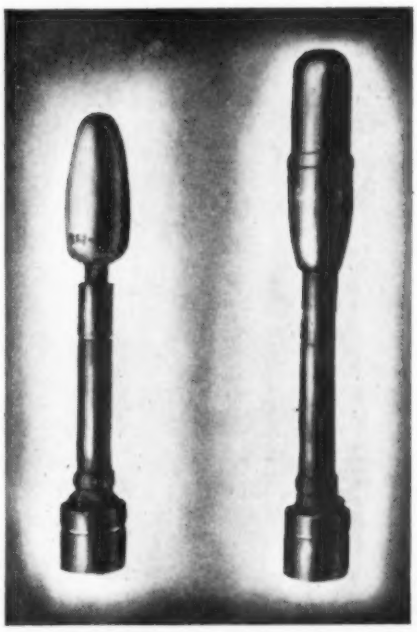
However, the life of the plastic tubes was limited; that is, the number of rockets that could be safely fired from each tube was restricted. Therefore, when the availability of the lightweight metals improved, magnesium tubes of comparable weight came into use. These tubes are made into 3-unit clusters interchangeable with the plastic type and are designated M15, supplementing in large production the M10.

Full advantage was taken of the characteristics of the M8 rocket when it was adapted by the Army Ground Forces for use in jungle warfare. The rocket has no recoil and can therefore be fired from a simple lightweight launcher so that great firepower can be transported completely by a single soldier. A short plastic tube, only slightly longer than the rocket itself and made with the same plastic construction as the M10 aircraft cluster, is used both as the packing or carrying container and as the launcher. This package type of rocket launcher for the 4.5-inch M8 series rockets is designated "Launcher, Rocket, 4.5-inch, M12."

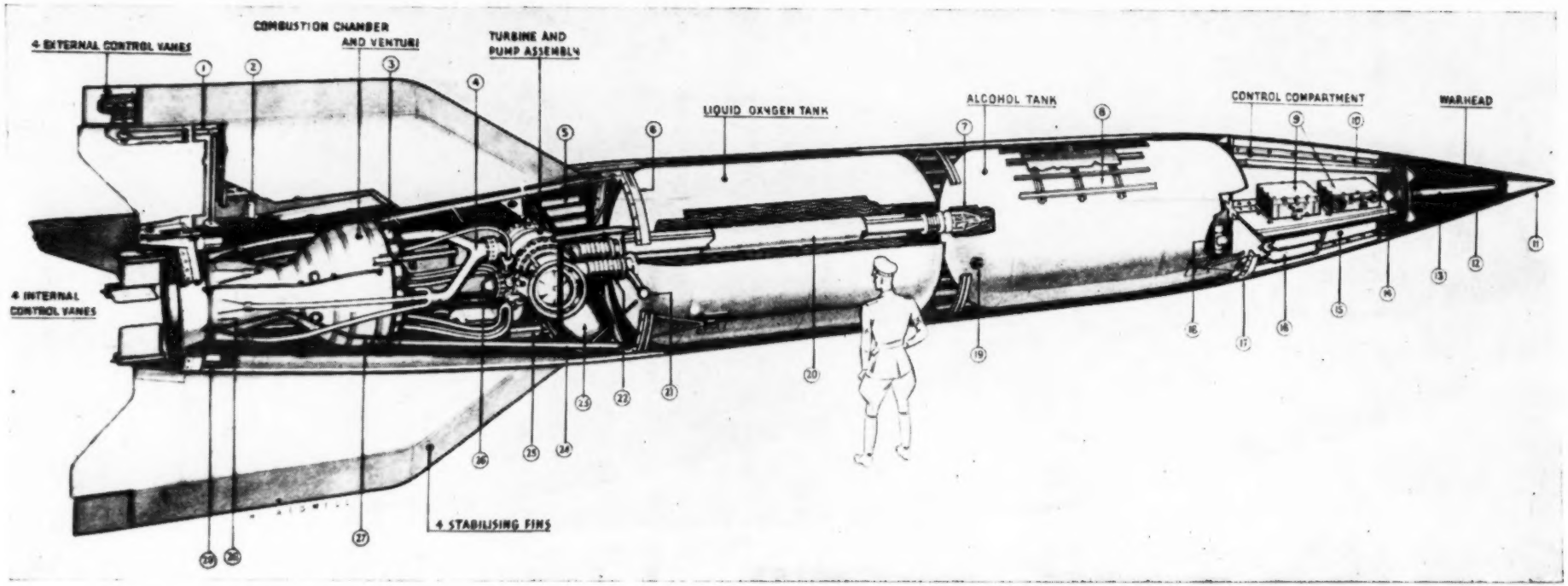
The launcher is provided with folding legs which in the carrying position are strapped alongside the tube but can be quickly released to support the launcher on the ground.

THE weight of the total package, rocket and launcher, is approximately sixty pounds. One man can transport this type of ammunition into locations where artillery comparable in firepower could not be taken and where even mules would have rough travel.

Modern warfare and the use of tanks, aircraft, and amphibious vehicles have brought out many new applications where it appears that rockets will offer an important contribution. New designs of rocket weapons using the very latest advancements in the fields of chemistry, metallurgy, and engineering will provide firepower superior to that even now believed possible. The rocket as a war weapon is back to stay.



The standard 2.36-in. smoke rocket (left) and present high-explosive rocket (right).



1. Chain drive to external control vanes. 2. Electric motor. 3. Burner cups. 4. Alcohol supply from pump. 5. Air bottles. 6. Rear joint ring and strong point for transport. 7. Servo-operated alcohol outlet valve. 8. Rocket shell construction. 9. Radio equipment. 10. Pipe leading from alcohol tank to warhead. 11. Nose, probably fitted with nose switch or other device for operating the warhead fuze. 12. Conduit carrying wires to nose of warhead. 13. Central exploder tube. 14. Electric fuze for warhead. 15. Plywood frame. 16. Nitrogen bottles. 17. Front joint ring and strong point for transport. 18. Pitch and azimuth gyros. 19. Alcohol filling point. 20. Double-walled alcohol delivery pipe to pump. 21. Oxygen filling point. 22. Concertina connections. 23. Hydrogen peroxide tank. 24. Tubular frame holding turbine and pump assembly. 25. Calcium permanganate tank; hydrogen permanganate steam generator for turbine is located behind this tank. 26. Oxygen distributor unit. 27. Alcohol pipes for subsidiary cooling. 28. Alcohol inlet to wall of rocket motor. 29. Electrohydraulic servo motors. (Illustration is from a British official photo.)

THE GERMAN STRATOSPHERE ROCKET, V2

BY ASSEMBLING recognizable parts of a number of German V2 rocket bombs that have descended on England, experts of the British Air Ministry have been able to determine how they are constructed and operated. V2 is a sharply pointed, streamlined projectile, 46 feet long and 5½ feet in diameter. With its 2,000-pound warhead and load of fuel it weighs about 27,000 pounds.

Its main components are: (1) The one-ton warhead—about the same as that in the V1; (2) A control compartment; (3) Two aluminum tanks holding 7,500 pounds of alcohol and 11,000 pounds of liquid oxygen, respectively; (4) A turbine and pump assembly, with a gas generator to drive the turbine; (5) A large combustion chamber and venturi into which the alcohol and oxygen are forced through jets; (6) Two sets of control vanes, one set operating internally in the jet stream and the other on the edges of the stabilizing fins.

In launching, the V2 is stood vertically on a concrete platform. Then the turbine, which is driven by superheated steam produced by mixing a very concentrated hydrogen peroxide with a solution of calcium permanganate, is started and drives the pumps. The pumps force the liquid oxygen and alcohol into the combustion chamber. The mixture is ignited electrically and the rocket takes off. The products of combustion are forced at high speed through the orifice in the rear end of a venturi. The energy so liberated creates a thrust of twenty-six tons which propels the rocket upward at high velocity.

The V2 travels vertically upward for a short time, after which a gyroscope operates the control vanes and curves the rocket toward the target until it is pointing upward at an angle of about forty-five degrees one minute after launching, when the fuel supply is cut off. The rocket is then traveling about 3,000 miles an hour. It continues up through the stratosphere to a height of sixty miles, then it descends following the same parabolic path a shell would take.

The V2 has a range of about 200 miles, and the time of flight from launching to impact is about 5 minutes. *Since the rocket's speed is much greater than sound it cannot be heard until after it has landed and exploded.*

Ammunition Production

The Rôle of the Field Director of Ammunition Plants

Col. T. C. Gerber

The Office of the Field Director of Ammunition Plants is in charge of the manufacture of all artillery ammunition, bombs, mines, grenades and rockets for our armies—the largest Government-owned industry of the Ordnance program administered by a single office.

THE United States is today the greatest producer of ammunition in history. The fifty-seven Government-owned contractor-operated ammunition plants of the Ordnance Department, under the jurisdiction of the Field Director of Ammunition Plants, comprise the greatest centrally administered industry group in the world. These plants produce more than ninety-five per cent of the military explosives and ammunition required by the War Department and also provide substantial quantities for the Navy and Lend-Lease.

The story of how this industry sprang up overnight through the coöperation of private enterprise with the Government is a familiar one to many persons who have followed the Ordnance program, but it is worthy of repetition because of its dramatic nature. As war became increasingly imminent in 1940, it was recognized that the facilities for producing ammunition in this country were entirely inadequate for modern warfare. Production at that time was confined to Picatinny Arsenal, certain Field Service renovation plants, and a few privately operated plants which were producing for foreign governments. Picatinny Arsenal was primarily intended for experimental production, while the private plants capable of turning out military explosives had a combined capacity which was in no way sufficient to meet the needs of war.

The industrial planning carried on by the Ordnance Department during the period between wars had resulted in information and procedures which indicated that the problem of supplying the metal components for ammunition could be met largely by adapting existing industrial facilities to the manufacture of these parts. However, no plants were in existence which could produce in sufficient quantities such basic raw materials as anhydrous ammonia, toluene, formaldehyde, and hexamine. Facilities for the production of military explosives, such as smokeless powder, ammonium picrate, TNT, and RDX were also inadequate, and no production lines had been created which could load and assemble shells, bombs, fuzes, rockets, and other items of ammunition on a mass-production basis.

THE period when active warfare would begin was recognized as being perilously close. The immediate creation of vast new capacity was a matter of paramount importance for the protection of the Nation. To build and operate ammunition plants on such a scale demanded construction experience and business knowledge which did not exist within the War Department in sufficient quantities to carry out the program unaided. Outside assistance was clearly needed. In this crisis, the Ordnance Department turned to the single place where knowledge and experience of this type could be found—to American private enterprise. It was at this time that Maj. Gen. L. H. Campbell, Jr., then in charge of the Facilities Division of Ordnance Industrial Service, first put into large-scale effect the principle of the Industry-Ordnance team. Contracts were entered into with many of the great, successful corporations of the country, under which, for a fixed fee, they would contribute their knowledge and experience to the design, construction, and operation of Government plants.

In executing contracts for ammunition facilities, it was necessary that a coordinated program be followed so that as the plants came into production the necessary powder and explosives would be available to meet the capacity of the loading plants. With this in mind, the first "wave" of plants was authorized by contracts executed during the latter half of 1940. This first wave provided facilities for the production of anhydrous ammonia, toluene, ammonium picrate, smokeless powder, and TNT. Provision was also made for loading plants which could assemble the metal components of ammunition to be received through the Ordnance district procurement system and load them with the required powder and explosives. Two typical contracts may be cited as examples of plants in the first wave. In July 1940, a contract for the operation of Indiana Ordnance Works was entered into with the Du Pont Company. This works was to produce smokeless powder, which is the standard propelling charge for almost every type of ammunition.

In March 1941, eight months after the contract was signed, this tremendous plant began producing powder and has since obtained a rate of output which has never before been attained in industrial history. The contract with Sanderson & Porter for the operation of the Elwood Ordnance Plant, Elwood, Ill., was signed in September 1940. Ground was broken for construction in November 1940, and the first items to be loaded were turned out in July 1941. Ever since that date, this gigantic plant, which loads a wide variety of shells and bombs, has been steadily pouring forth a great stream of death and destruction for the Axis. The story might be repeated for some sixty plants in three great waves between 1940 and 1942, until today our ammunition capacity is supreme in the entire world.

IN surveying the history of operations of these facilities, it is possible to observe certain major trends and to note important attainments in ammunition manufacturing. The most significant trend has been the constant demonstration that man power could be reduced at the same time that production was being maintained or increased. A second trend has been a decline in operating costs based on technological improvements and improved procedures in such fields as processing, maintenance, accounting, and purchasing.

Colonel Gerber is Field Director of Ammunition Plants, Office of the Chief of Ordnance, St. Louis, Mo.

"Ammunition," as used in this article, includes all artillery ammunition larger than caliber .50, and all bombs, mines, grenades, rockets, and similar items.

These favorable trends have, to a considerable extent, reflected the success of the work of the Office of the Field Director of Ammunition Plants which was established in St. Louis in August 1942. This office has served as supervisor, advisor, and trouble shooter for the Government-owned contractor-operated ammunition industry. In addition, it has controlled rates of production through the distribution among plants of the over-all ammunition requirements which are established by the Chief of Ordnance, based upon the ever-changing Army Supply Program. The activities of the office fall generally into two main categories: (1) those carried out directly and (2) those carried out through the functioning of industry integration committees.

The industry integration committee is a logical outgrowth of operations under the cost-plus-fixed-fee contracts of the Ordnance Department. Under such contracts, the usual incentives to economy and efficiency do not exist, as the fee is not contingent upon performance. This factor was the basis for much criticism of cost-plus-fixed-fee contracts. To meet this problem, a competitive spirit was created by comparing costs and efficiency of operation for similar plants operated by different contractors. Under this system, a powder plant operated by one nationally known company has great interest in keeping its costs in line with comparable costs at a powder plant operated by every other company. None of these great corporations would desire to create the impression that they are less efficient operators than their peacetime competitors or that they are not giving their most efficient services to the Government in time of war.

Major groups of ammunition plants are the TNT plants, the smokeless-powder plants, the anhydrous ammonia plants, and the loading plants. The plant managers of each of these major groups make up an industry integration committee for that industry. The activities of all committees are coordinated by the deputy field director, who is a civilian. It is his responsibility to maintain close contact with all plant managers and to discuss their problems with them on an informal, man-to-man basis. This procedure permits a degree of understanding and cooperation between the contractors and the Field Director's Office which would not be possible if all key personnel of the office were officers of the Army.

IN an article entitled "Ammunition Production" published in the March-April 1943 ARMY ORDNANCE, *Colonel Gerber described the organization and functions of the Office of the Field Director of Ammunition Plants which was established in St. Louis, Mo., on August 7, 1942, under the provisions of Ordnance Department Order 305. After more than two years of operation, this office can point with pride to a record for efficiency and attainment which recently resulted in a commendatory report by Representative A. J. Engel of Michigan on the floor of the House of Representatives. His findings were published in Army Ordnance Association Report No. 6, August 21, 1944. The Office of the Field Director of Ammunition Plants was also discussed in Army Ordnance Report No. 4, March 15, 1944.*—EDITOR.

APPROXIMATELY once a month the managers assemble and discuss mutual problems of operation. Procedures which have been developed at one plant in the group are made available for the use of other plants of the same group and, where applicable, to all other plants in the entire ammunition industry. Special committees may be established to investigate specific problems and to make recommendations based on the results of their studies. Committee action of this type has resulted in standardization and improvement of maintenance policies, accounting procedures, and many other phases of operation.

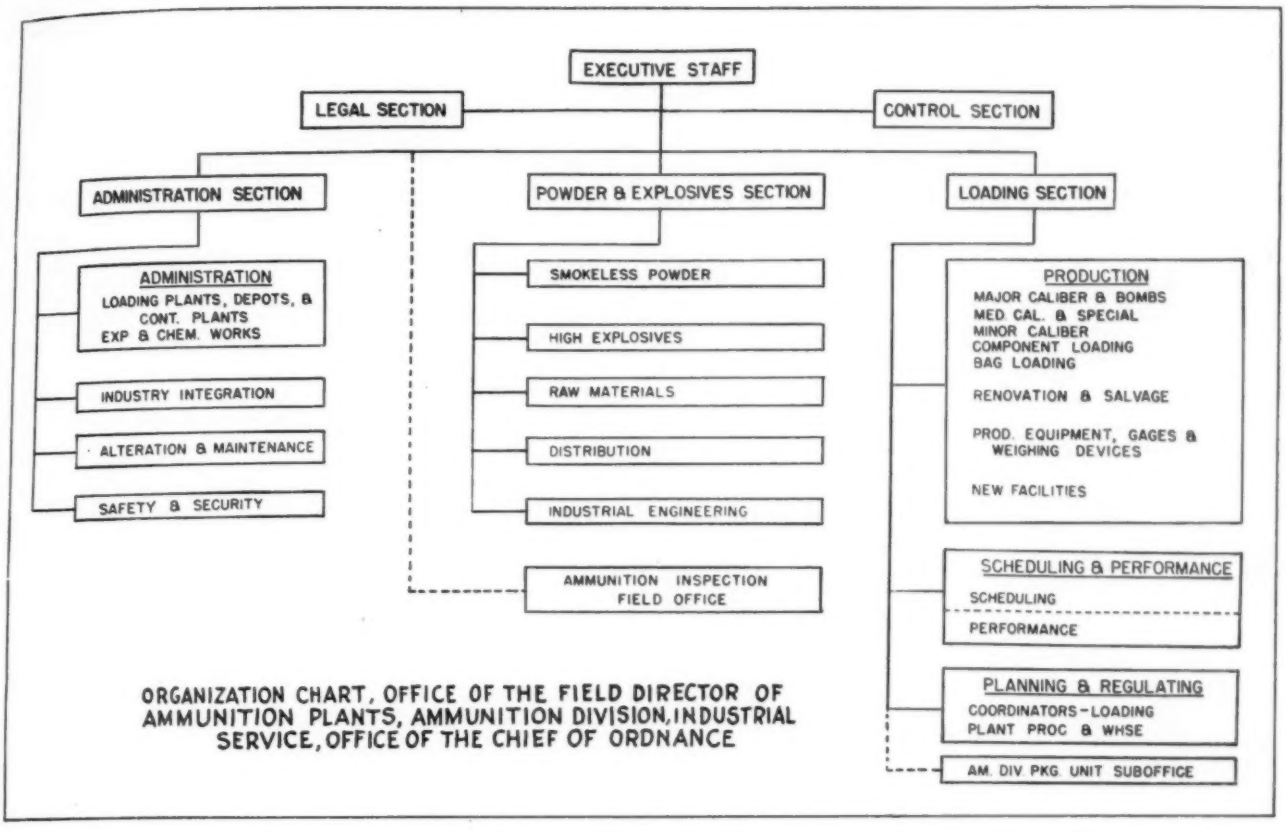
This mutual coöperation for efficiency purposes among contractors operating Government-owned plants has been approved by the War Production Board and the Attorney General of the United States, and represents one of the most significant demonstrations of the value of consolidating the efforts and talents of the leading corporations in the country. It has been clearly demonstrated that a pattern of coöperation among large corporations which might prove objectionable when used for private profit can result in benefit to the Nation under the proper circumstances.

In addition to furnishing over-all supervision for the work of the industry integration committees, the Field Director's office exercises direct control over the scheduling and techniques involved in the production of ammunition. Here are assembled military and civilian experts who know every technical aspect of ammunition manufacturing, as well as a group of officers who have taken part in the entire legal and administrative history of operation of Government-owned plants under the cost-plus-fixed-fee type of operation. The office is divided into five major organizational sections, as shown on the chart on page 239.

The administrative functions of the office are performed by the administration section, the legal section, and the control section. The administration section has the responsibility for assisting with the solution of all the administrative problems which may arise in an industry whose output is valued at more than $2,000,000,000 a year. Difficulties of every nature occur at these gigantic industrial facilities, and each moment of unnecessary delay in solving a problem may result in needless expenditure of public funds and in hampering the war effort.

The fifty-seven ammunition plants and six Government-owned contractor-operated field service depots are divided among four administrators who have been well qualified through service as commanding officers at Government-owned contractor-operated plants and by previous business experience in civilian life. Service as commanding officers has given to the administrators a knowledge of the actual functioning and operation of plants that are producing under cost-plus-fixed-fee contracts, with the result that they are able to approach administrative problems of these plants with proper comprehension and understanding.

The nature of problems which may be brought to the attention of the administration section is almost unlimited. The fact that most plants are located at a considerable distance from population centers results in



ORGANIZATION CHART, OFFICE OF THE FIELD DIRECTOR OF AMMUNITION PLANTS, AMMUNITION DIVISION, INDUSTRIAL SERVICE, OFFICE OF THE CHIEF OF ORDNANCE

a requirement for on-plant housing and special transportation facilities. Labor supply difficulties arising from lack of housing or transportation become a serious administrative problem which must be carefully weighed, and when a determination is made it must be followed through to obtain whatever facilities are required to keep the plant operating properly. The distances which workers must travel to reach most ammunition plants make it mandatory that special eating facilities be provided at the plant. This requires that an administrative determination be made by the contractor as to whether such facilities should be operated by the contractor who operates the plant or by a concessionaire. A further determination must be made as to what expenses incident to services and equipment the Government will reimburse and what costs and expenses will be defrayed from income received from sale of food to employees.

The manner in which the contractor uses his personnel is also of great interest to the administrators. Frequently they may note instances in which the man-power usage of one contractor for a particular type of work is out of line with that for a comparable contractor. Similar discrepancies may arise in the usage of Ordnance civilian personnel on a commanding officer's staff at two comparable plants. In such cases the administrators must analyze the reasons for the discrepancies and see that corrective action is taken if the variances are not warranted.

POLICIES and practices of the contractors, as set forth in employee welfare plans, office procedure manuals, and other publications are studied by the administrators, and suggestions concerning such matters are offered to the contractors. When a contractor advocates a practice which appears unsuitable for application to the ammunition industry, information is provided showing why the practice appears objectionable. Analysis of this type has been particularly necessary in the field of wage and salary administration, and the wage and salary structures of almost every facility reflect the administrative action of the Field Director's office. In addition to over-all examination of wage and labor policies, the Field Director must give specific authority for approval of any contractor's salary which amounts to $6,000 or more annually.

A very important responsibility of the administration section is to consider all projects for construction, alteration, or maintenance which are submitted by the various facilities. Such projects are very numerous, and each requires careful analysis and weighing of the advantages and disadvantages of carrying the project through to completion. The study of these projects requires the services of skilled construction engineers and other specialists. When a project is considered favorably, it is forwarded to Washington for the approval of higher authority, and when this approval is obtained the administration section has the responsibility for following the project through from its inception until the date of its completion.

The relationship of the administration section to the commanding officers' organizations at the plants is very close. All administrative problems upon which the commanding officer desires advice, or for which outside assistance is requested, are referred to the administrators. It is also their responsibility to analyze reports made by representatives of the Inspector General and to see that corrective action is taken when indicated. The administration section, through its safety and security liaison officer, has been instrumental in standardizing plant protection and safety practices at the plants to such an extent that guard and fire forces have been reduced by almost

two-thirds in the past twenty-four months, and quantities of critical fire-fighting and plant-protection equipment have been released for use elsewhere.

The legal section is made up of officers who have literally "grown up" with cost-plus-fixed-fee contracts. Members of this section have written almost all such contracts covering ammunition plants, together with all supplements, change orders, and other modifications of the original contracts. They have become familiar with the special problems which arise in connection with this relatively new and unique legal instrument and have been in a position to furnish substantial aid regarding legal problems to both contractors and commanding officers. In addition, the legal section interprets and applies to Government-owned contractor-operated facilities the procurement regulations issued by the Army Service Forces, the Ordnance procurement instructions which have been published to assist in the administration of cost-plus-fixed-fee contracts, Army Regulations, Army Service Forces' circulars, War Department circulars, and a wide range of other publications and directives.

The control section is responsible for establishing and improving internal office practices and procedures and carrying out local office-management activities. In addition, it coördinates the requirements for recurring reports, analyzes incoming directives, coördinates outgoing letters and instructions, and prepares various reports on activities and progress. This section also assists the administration section in salary-administration matters. The program for demobilization planning, covering both the Office of the Field Director of Ammunition Plants and the facilities under its jurisdiction, is coördinated by this section.

In addition to furnishing administrative assistance to the plants, the Office of the Field Director of Ammunition Plants has the responsibility for giving technical advice and for establishing production schedules at each facility. This work is divided between the powder and explosives section and the loading section. The powder and explosives section serves the facilities which manufacture such basic chemicals as acids, anhydrous ammonia, formaldehyde, hexamine, methanol and toluene, and such explosives as smokeless powder, TNT, RDX, pentolite, tetryl, ammonium picrate, and lead azide.

THE loading section serves the plants which load shells, bombs, propelling charges, fuzes, rockets, mines, and grenades. The over-all production requirements for these various items of ammunition are first received by the loading section and are then broken down into production schedules for each loading plant. Using the loading section requirements, the powder and explosives section schedules the production so that the necessary powder and explosives may be made available to loading plants with a minimum of crosshauling. The staffs of these two units include highly qualified experts, both military and civilian, who are available for the solution of any operating problems which may arise at the facilities.

The loading experts in the Office of the Field Director have been responsible for many changes in the design of ammunition which have improved the type of ammunition and simplified its manufacture. They have also designed improvements in methods of packing, storing, and transporting ammunition. Standard-practice manuals covering the loading of almost every item of ammunition have been prepared by the loading section and circulated to all plants loading the item covered. Both in the loading section and the powder and explosives section the technical personnel have extensive backgrounds in the manufacture of ammunition. Many of these experts were brought in from Government arsenals or from privately owned powder and explosives plants and in addition have served at least briefly at Government-owned Government-operated ammunition plants.

In addition to the main functional units described above, the Field Director exercises administrative control over the ammunition inspection field office of the Inspection Branch, Ammunition Division, which has been established in the Office of the Field Director of Ammunition Plants. The functions of this inspection office, though primarily a responsibility of the chief of the Inspection Branch of the Ammunition Division in Washington, are closely related to the work of the Field Director's office through the circumstance that all ammunition items produced by the Government-owned contractor-operated plants must be presented for acceptance by Inspection Branch representatives.

After more than two years of operation, certain definite conclusions can be drawn regarding the ammunition production program as administered by the Office of the Field Director of Ammunition Plants. First, no serious complications have arisen in the program which have not been quickly solved; secondly, the supply of ammunition has been adequate and, in the case of most items, substantial reserves have been built up; thirdly, continuing improvements, both in technological and administrative procedures, have made possible steady improvements in efficiency, with resulting substantial economies both in man power and in money.

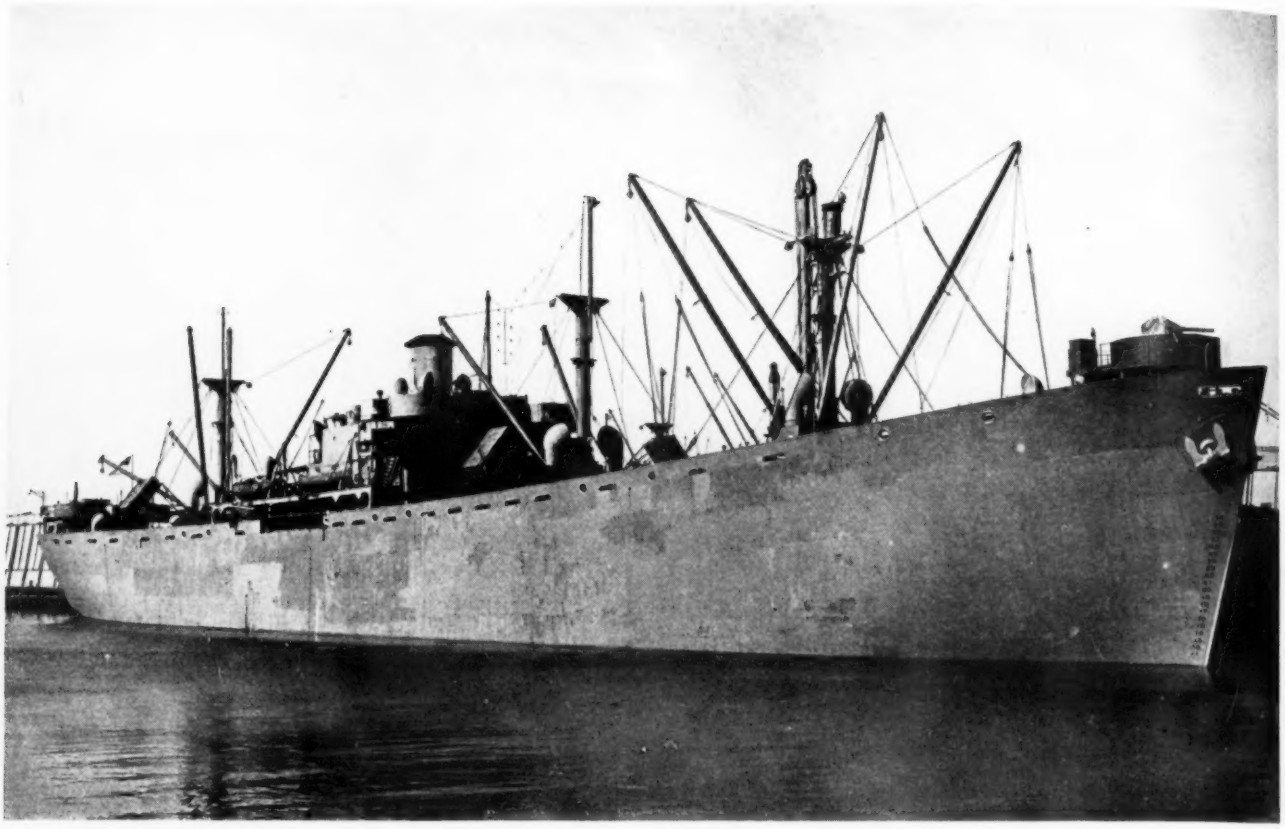
Our progress in man-power usage has been most gratifying in this era of critical labor supply. The percentage of women utilized has been greatly increased even in the short period that our plants have been in operation, and we have introduced women into many jobs where both practice and tradition said they could never work. We have released from purely overhead activities, such as plant protection, more than enough man power to form an infantry division. Our usage of medical doctors, trained nurses, and first-aid workers has been substantially reduced, and we are constantly surveying remaining medical personnel to make certain that we are retaining only the minimum required for efficiently carrying out our medical responsibility. Without such activities it would have been almost impossible to meet our production schedules in the face of nationwide man-power shortages.

As do so many others in supply services, the officers connected with the ammunition program often feel "out of it" when they read of the accomplishments in the active theaters of war. However, it is a constant source of pleasure for all of us to realize that we have had a vital rôle in manufacturing the artillery shells which are blasting pathways for our troops into the heart of Germany and Japan and loading the bombs which are falling upon those two doomed nations.

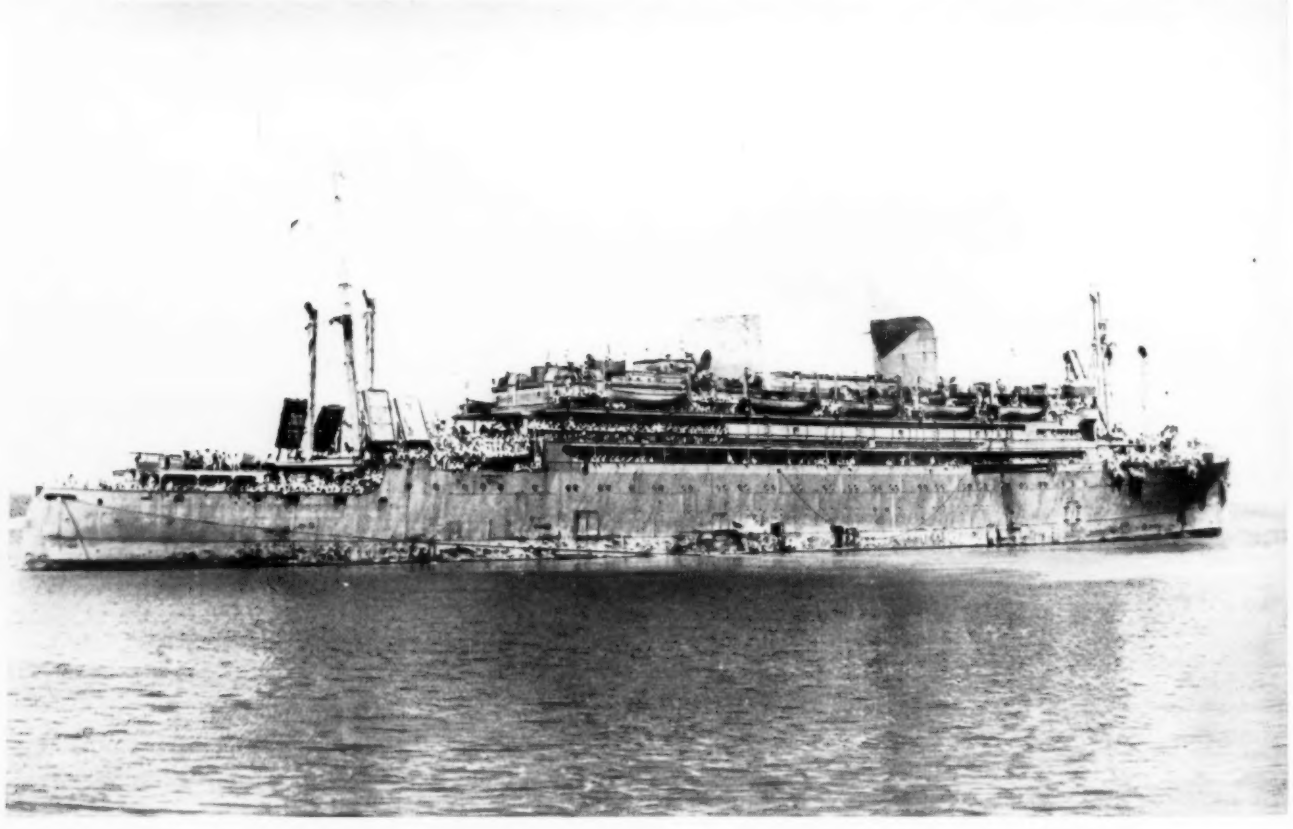
"Ships of the Army"

The United States Army operates one of the world's largest merchant fleets. The great convoys bridging the continents are directed and protected by the Navy, but many of the transports and freighters in these convoys are operated by the Army through its Transportation Corps, and some of them are Army-owned. There are at present more than 1,600 large vessels in the Army's fleet, manned by 30,000 civilian merchant mariners. In addition, thousands of "GI sailors" man a considerable part of the Corps' 11,000 small craft in interisland and coastwise operations in the Pacific, Europe, and the Near East These tiny vessels took a prominent part in the invasion of France and are proving invaluable in the Pacific. The Transportation Corps also operates all the Army's hospital ships, of which there will soon be 29. A number of representative types of vessels in the "Army's navy" are shown in the accompanying Signal Corps photos.

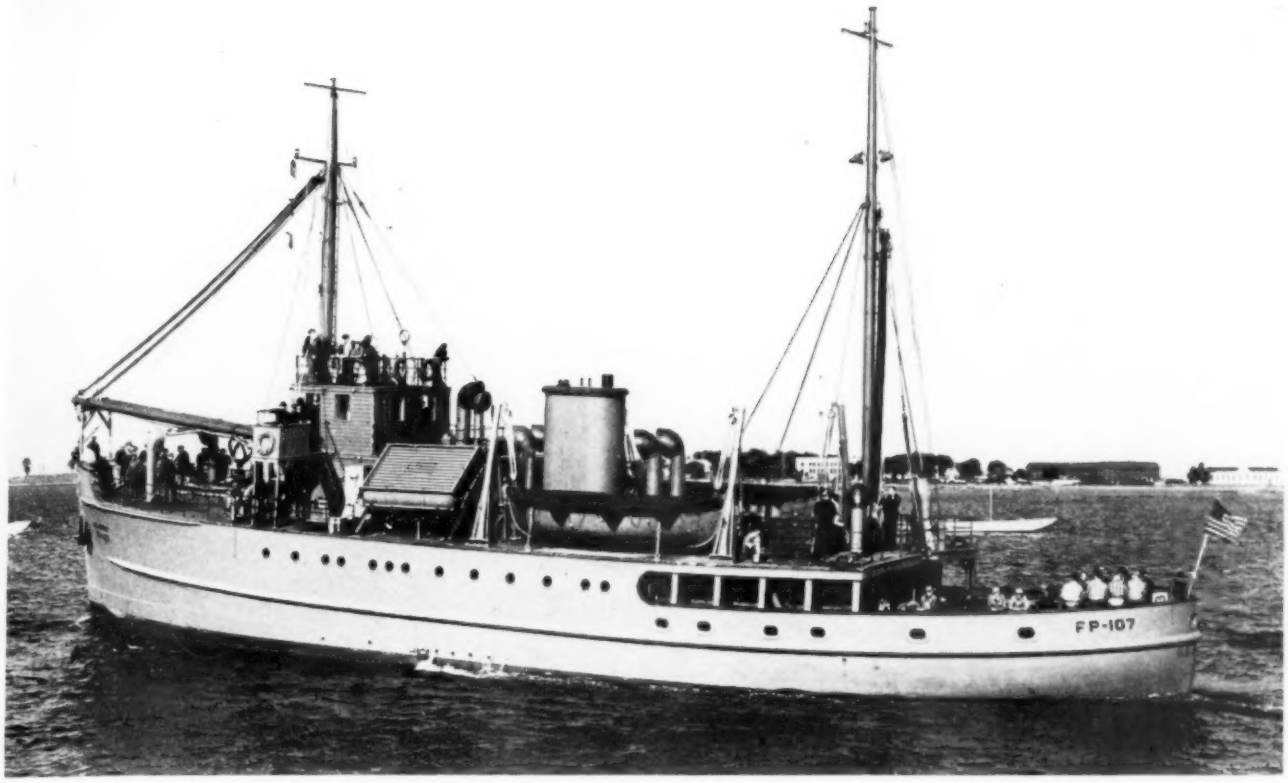
Ships of the "Blue-Water" Fleet



Men and materials are the sinews of war, and the ships of the Army form a floating bridge across the seven seas carrying our troops and equipment to the far-flung battle fronts. The Liberty ship, above, is one of a huge fleet of American-built merchant vessels which have made possible the flow of supplies to all fronts. Below is an Army transport at New Caledonia.

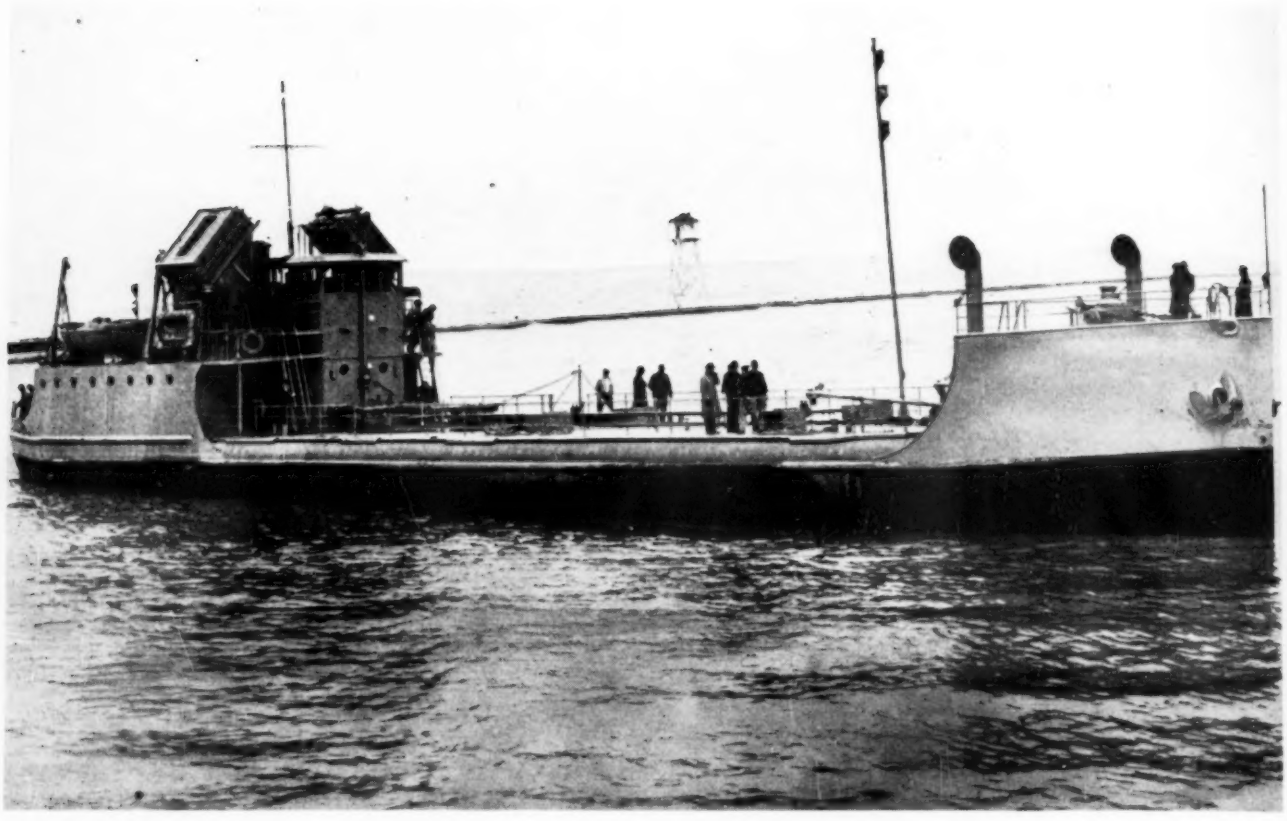


Interisland and Coastal Vessels



In addition to its "blue-water" fleet the Army Transportation Corps operates many types of small freighters and harbor craft such as the 140-foot freight-supply vessel above and the 102-foot Diesel freighter below. More than 15,000 small craft were procured by the Corps and sent overseas in 1944. They have proved invaluable in transporting supplies in the Pacific.

Oil for a Motorized Army



The tanks, trucks, planes, amphibious vehicles, and landing craft used by our invasion forces, particularly in the far reaches of the Pacific, have made the supply of oil and gasoline a vital problem. This is being solved by such vessels as the 162-foot Army tanker above and the 120-foot barge below which can carry gas or water to even the most inaccessible islands.

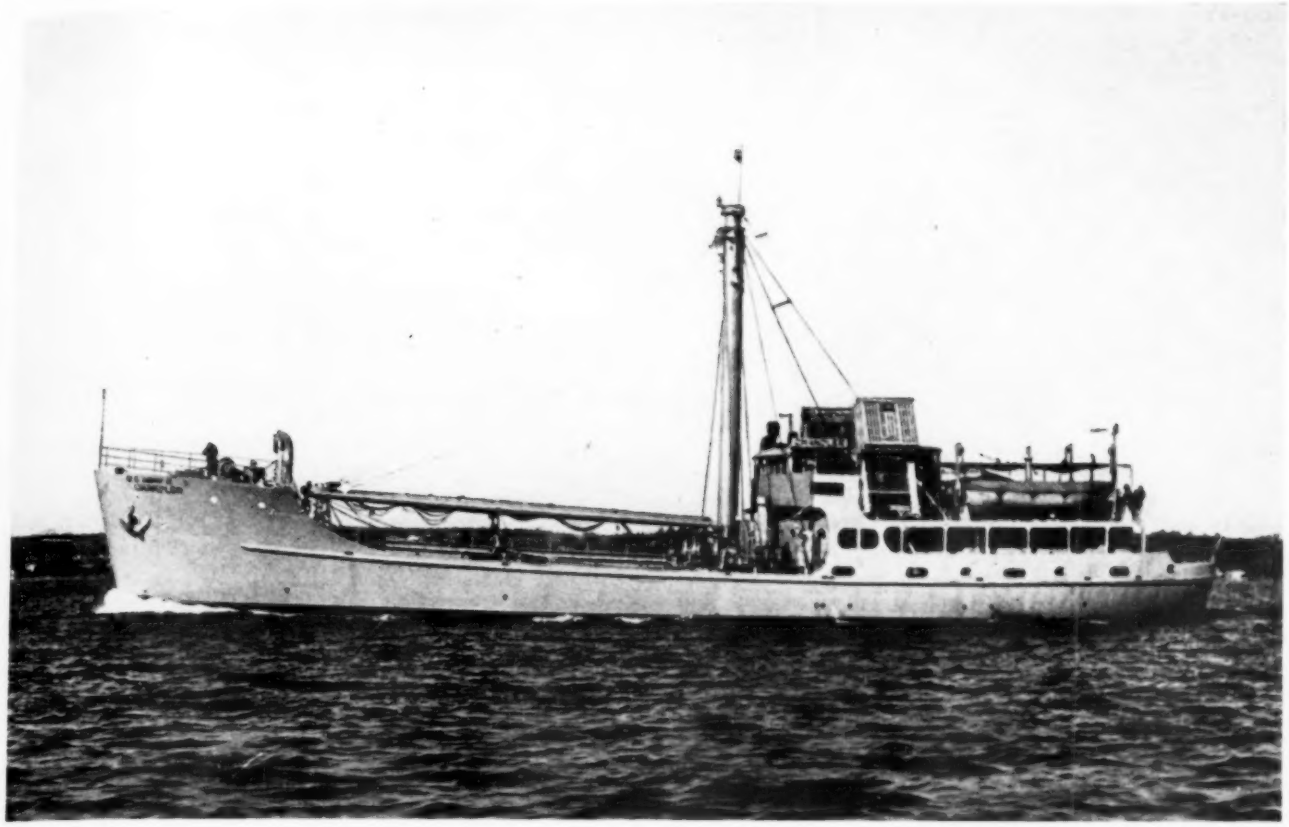
The Army's Seahorses

The first supply-bearing ship to enter Cherbourg Harbor after the invasion of France was the seagoing tug *Owl* shown above towing barges loaded with equipment for reconstruction of the port. Below is the trawler *Tee-Bee*, a 55-foot towboat built in Australia for use in the Southwest Pacific area. The *Owl* is "armed to the teeth," and even the *Tee-Bee* mounts a machine gun.

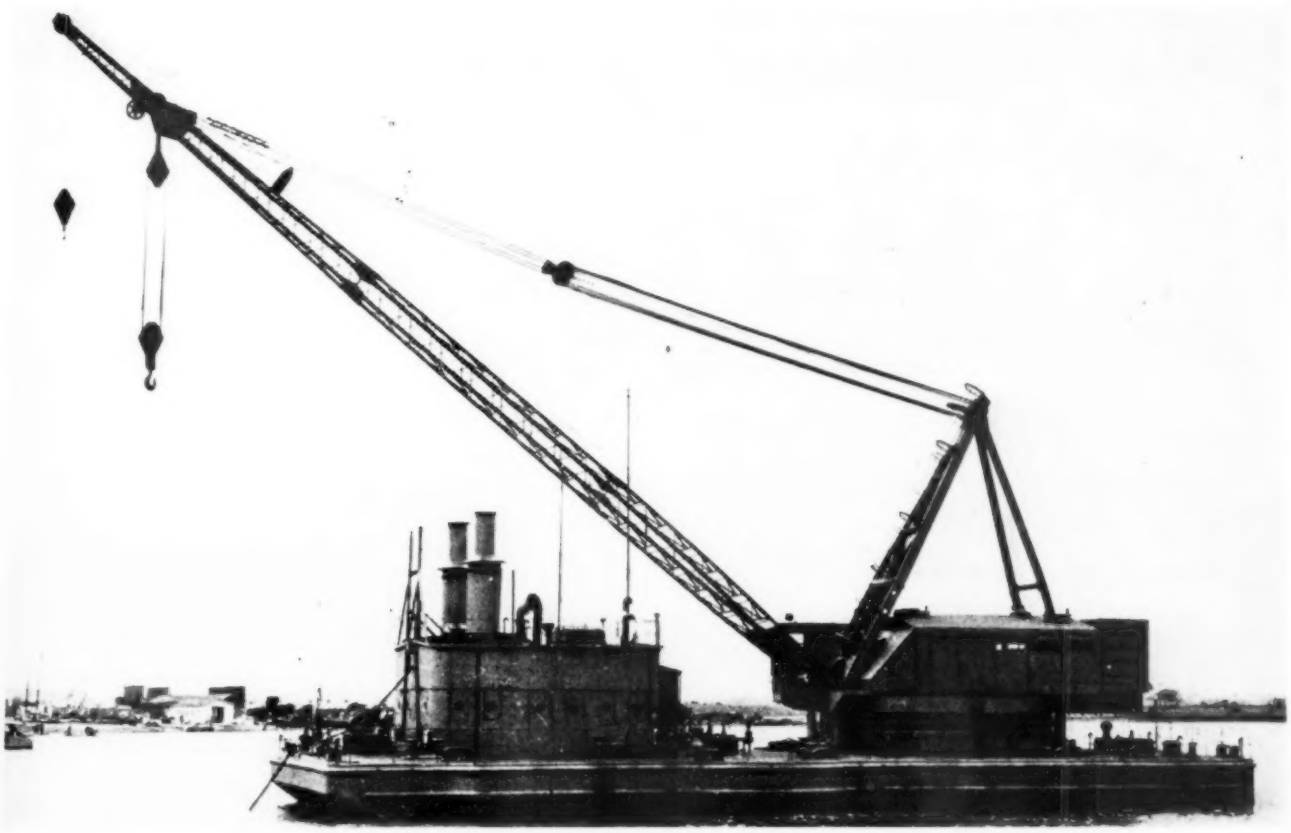
Supply Craft for Inland Waters

The 65-foot freighter *T-10,* above, is the smallest supply vessel in the Army's fleet. Despite its size it can carry a generous amount of freight and can enter relatively shallow waters. It is especially suited for inland waterways or for interisland supply. Below is an American power barge preparing to land vital supplies and equipment at Gertrude Cove, Kiska, Alaska.

Retriever and Crane Vessels

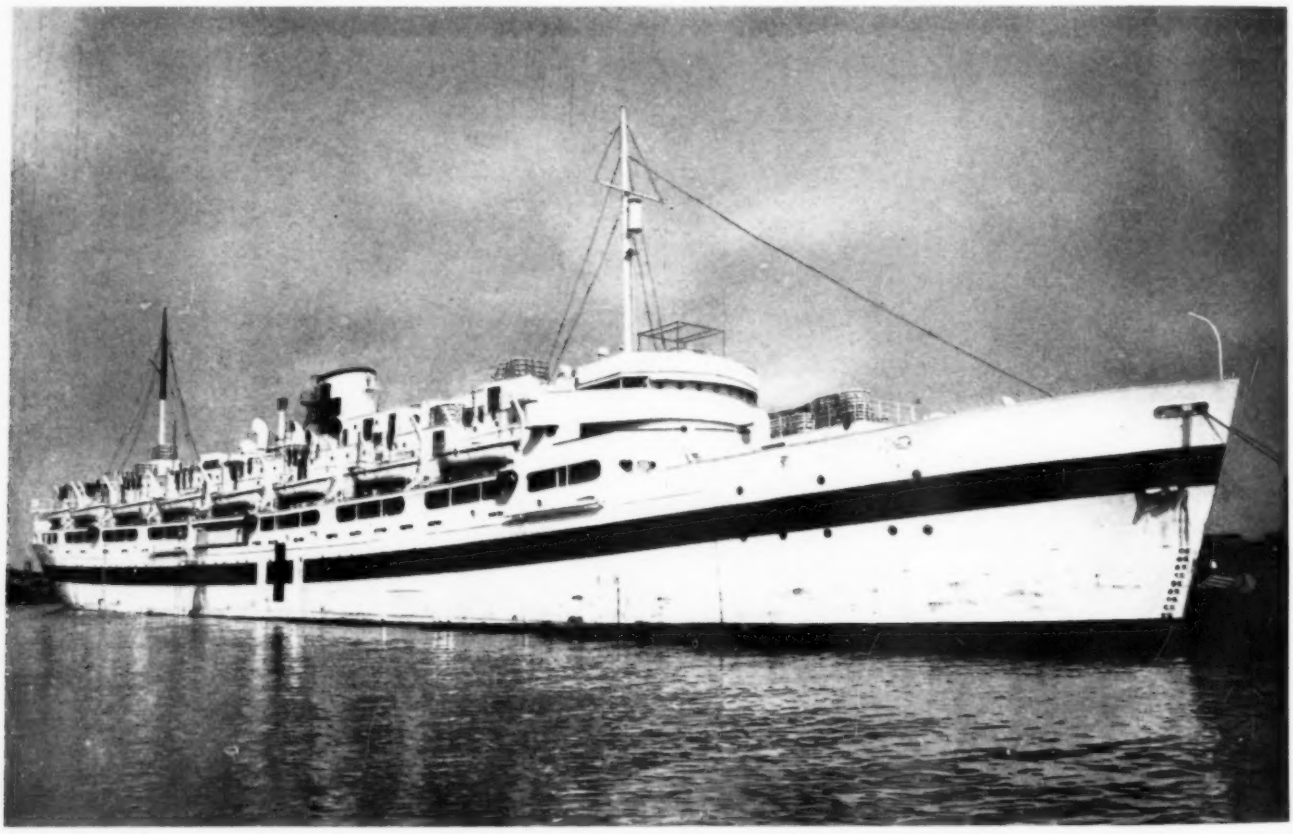


Designed for retrieving damaged airplanes or small craft from the water, the *Chandler*, above, is also operated by the Army as is the 110-foot steel Whirley crane barge, below. The crane has a 60-ton capacity and is used for unloading ships where dock facilities are limited or where ships must be lightened before entering shallow harbors. It is also useful in port repair.



Ships of Mercy

The Army's high-speed crash boat, above, is designed to rescue fliers downed at sea. Resembling a PT boat, it is made entirely of wood and is equipped with medical facilities, machine guns, and a cannon. The hospital ship *Blanche F. Sigman,* below, is one of a fleet of these mercy ships soon to number 29 vessels with a total capacity of more than 18,000 sick and wounded.



The Age of Steam

The Influence of Armament on World History—V

Maj. Gen. J. F. C. Fuller

BENEATH the ordered absolutism of the eighteenth century there lurked powerful explosive forces, some of the most violent of which had sprung into being during the Puritan Revolution in England. There, the divine right of kings was jettisoned; mercantilism was vastly fortified by Cromwell's Navigation Act of 1651, and a new political philosophy was planted by Thomas Hobbes (1588-1679) and John Locke (1632-1704).

This revolution had barely ended when, in 1694, the Bank of England was created by a group of men of high mercantile standing, to be followed four years later by the introduction of Thomas Savery's steam pumping engine.

War was endemic in the mercantile system, because its main object was to extract wealth from other nations. In 1776, this was noted by Adam Smith. In his "Inquiry into the Nature and Causes of the Wealth of Nations," he wrote: "The capricious ambition of kings and ministers has not during the present and preceding century been more fatal to the repose of Europe than the impertinent jealousy of merchants and manufacturers."[1] The circle was indeed a vicious one. Mercantilism meant war; war to support itself demanded manufacturing power; and manufacturers fortified mercantilism.

Until 1757, when Clive's victory at Plassey unleashed the hoarded treasure of Bengal, money in sufficient quantity was lacking to finance manufacture. Then, as Brooks Adams writes: "Probably nothing has ever equaled the rapidity of the change which followed. In 1760 the flying shuttle appeared, and coal began to replace wood in smelting. In 1764 Hargreaves invented the spinning jenny; in 1779 Crompton contrived the mule; in 1785 Cartwright patented the power loom; and, chief of all, in 1768 Watt matured the steam engine—the most perfect of all vents of centralizing energy."[2]

The Industrial Revolution, which now set in, synchronized with the preaching of a new way of life by a host of philosophers—Montesquieu (1689-1755), Burlamaqui (1694-1748), Voltaire (1694-1778), Rousseau (1712-1778), Beccaria (1735-1794), and Condorcet (1743-1794), to mention a few—their central doctrine being that natural society is a state of equality and liberty. In turn, this philosophy demanded a people's army to safeguard it against tyranny, a demand voiced by Guibert in his "Essai général de tactique," published in 1772. In it he proclaimed that European hegemony would fall to whichever nation first created a true national army.[3] Also, in his "Esquisse d'un tableau historique des progrès de l'esprit humain," Condorcet connected the rise of infantry with the rise of democracy, though it would have been more correct to have reversed this sequence, because the musket made the infantryman, and the infantryman made the democrat. Power to kill, and therefore to enforce freedom, was the essence of the question.

In 1815, the year Napoleon was finally defeated, the first steamship made her passage from Greenock to London. Four years later, the New York-built "Savannah" was the first steamer to cross the Atlantic. Six years later still, the first true railway was constructed by George Stephenson between Stockton and Darlington. Here were Cyclopean forces which were about to change the face of the world, and, in changing it, raise war from the cockpit of gladiatorial armies to the grand amphitheater of contending nations.

THE first demonstration of this new form of war was held in America, to become known to history as the American Revolution or the War of American Independence. Ideologically, it was a revolt against tyranny, a people's war, and a war of loose rather than of parade movements.[4] Shooting to kill and trickery to deceive, so thoroughly indulged in by the Americans, were as contrary to the rules of eighteenth-century warfare as they were patent to Indian fighting. Even Washington, on one occasion, instructed some of his soldiers who wore red coats to sew on them the buttons of an English regiment, pass through the English lines, and kidnap General Clinton.[5]

During this war there struggled into daylight not only the spirit of democratic nationalism, but also its logical sequent—the mass army. Carried into France, the ideology of the War of American Independence gave birth to the "sans culottism" of the French Revolution—the antithesis of "courtiership." Terror became a weapon under the Jacobins, and, in theory at least, war was rendered total and, in consequence, brutal. In ideal, war was no longer a royal gamble to settle a frontier or a dynasty. Instead, its aim was the destruction of the enemy until the moment arrived when "the death of an enemy soldier became useless to liberty."[6]

In February 1794, Carnot made it a rule "to act in mass formation. . . . Give battle on a large scale and pursue the enemy till he is utterly destroyed."[7] All *émigrés* when caught were to be killed, and Robespierre decreed that "no quarter be shown to British and Hanoverian soldiers."[8] Thus all rules of war were rendered absurd.

The first practical step taken in establishing this return to unrestricted warfare was the introduction of conscription by General Jourdan and the Council of Five Hundred in 1798. As Colonel Maude wrote in the eleventh

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General Fuller is author of the following works, among others: "On Future Warfare," 1928; "India in Revolt," 1931; "Lectures on F. S. R. II," 1931; "Lectures on F. S. R. III (Operations between Mechanized Forces)," 1932; "War and Western Civilization, 1832-1932," 1932; "General Grant (A Biography for Young Americans)," 1932; "The Dragon's Teeth (A Study of War and Peace)," 1932; "Generalship, Its Diseases and Their Cure," 1933; "Grant and Lee (A Study in Personality and Generalship)," 1933; "Empire Unity and Defence," 1934; "The Army in My Time," 1935; "The First of the League Wars," 1936; "Memoirs of an Unconventional Soldier," 1937; "The Last of the Gentlemen's Wars," 1937; "Towards Armageddon," 1937; "The Decisive Battles," 1939; "Decisive Battles of the U. S. A.," 1942; "Machine Warfare," 1942; "Armored Warfare," 1943. Special correspondent, London *Daily Mail*, Italo-Abyssinian War. Major General, British Army, Retired. C. B., C. B. E., D. S. O. London, England.

[1] Reference notes are published in full on page 255.

edition of the Encyclopædia Britannica: this power to enroll a nation "alone rendered the Napoleonic policy of conquest possible. 'I can afford to expend 30,000 men a month'; this boast of Napoleon's, made to Metternich at Schönbrunn in 1805, has determined the trend of events from that day forward, not only on the battlefield, but also in the workshops."[9]

As the training of the French conscripts was negligible, tactics were irregular and based on man and musket. The skirmishers were, as Sir Robert Wilson said, "as sharp-sighted as ferrets, and as active as squirrels."[10] And the Duke of York's aide-de-camp wrote: "No mobbed fox was ever more put to it to make his escape than we were, being at times nearly surrounded."[11] Other nations followed suit, and light infantry became a permanent service in every army.[12]

Under Napoleon, armies were quadrupled in size and battles in slaughter, power being sought through multiplication, until, as it was said, God Himself had no choice but to side with the biggest battalions. Reviewing this development, Jomini was of the opinion that war would become "a bloody and most unreasonable struggle between great masses equipped with weapons of unimaginable power. We might," he commented, "see again wars of peoples like those of the fourth century; we might be forced to live again through the centuries of the Huns, the Vandals, and the Tartars."[13]

This was prophecy, indeed, for a hundred years later we find Spengler writing: "For this is the century of gigantic permanent armies and universal compulsory service. . . . Ever since Napoleon, hundreds of thousands, and latterly millions of men have stood ready to march. . . . It is a war without war, a war of overbidding in equipment and preparedness, a war of figures and tempo and technics, and the diplomatic dealings have not been of court with court, but of headquarters with headquarters."[14]

In Napoleon, the Power Age found its prophet; hence onward, a new Islamism was to engulf the Western world. Its Koran was written by Karl von Clausewitz (1780-1831), a Prussian general. Dying in 1831, his writings were edited and published by his widow, and the first three volumes, containing his master work—an unfinished exposition on the philosophy of war—was entitled "Vom Kriege" (On War). In succeeding years it molded the German military mind and carried the Prussian armies to victory in 1866 and 1870. Since then it has become the war creed of all nations. The following quotations from his great work will give a fairly clear picture of his philosophy:

"War belongs not to the province of arts and sciences but to the province of social life. . . . State policy is the womb in which war is developed, in which its outlines lie hidden in a rudimentary state, like the qualities of living creatures in their germs. . . . War is nothing but a duel on an extensive scale. . . . War should be waged with the whole might of the national power. . . . War is . . . a continuation of political intercourse, with a mixture of other means. . . . War is an act of violence pushed to its utmost bounds."[15]

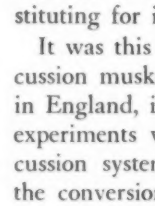
THE aim of this "Spartanism" was to turn the state into a military machine and at the very time when steam power was beginning to turn it into an industrial machine. Hence onward, both armies and factories increasingly ceased to be the servants of the people and to become their masters. Henceforth the mass struggle dominated life ("The Origin of Species," 1859), work ("Das Kapital," 1867), and war ("Vom Kriege," 1832), Darwin, Marx, and Clausewitz becoming the ruling trinity of the nineteenth and twentieth centuries. Nevertheless, without steam power there could have been no radical change, because the struggle for existence, as popularized by Darwin, would never have been carried into the factories and thence onto the battlefields. In a little over a hundred years all was transformed.

Until about 1730, British manufacture depended on foreign inventions. Ten years later, smelting with coal and coke, instead of with charcoal, was introduced. In 1740, the annual output of iron in Great Britain was 17,000 tons; in 1800, it was 150,000 tons; and in 1840, 1,400,000 tons. In the second half of the eighteenth century, machines began to make machines: this was the true beginning of the Industrial Revolution. In 1769, the year Napoleon and Wellington were born, Cugnot, in France, invented the first steam carriage. And, in 1815, the year Napoleon was finally defeated, the first steamship made her passage from Greenock to London.[16] Four years later, the New York-built SAVANNAH was the first steamer to cross the Atlantic.[17] Six years later still, the first true railway was constructed by George Stephenson between Stockton and Darlington.

Here were Cyclopean forces which were about to change the face of the world, and, in changing it, raise war from the cockpit of gladiatorial armies to the grand amphitheater of contending nations.

The two outstanding military inventions of the first half of the nineteenth century were the percussion cap and the cylindro-conoidal bullet, which gave further impetus to the quantity theory of war. The first was impossible until the discovery of an explosive which detonated on concussion, and it was not until L. G. Brugnatelli, in 1798, produced "fulminating silver" that this became practicable. Next, in 1800, Edward Charles Howard discovered fulminate of mercury. Seven years later, the Rev. A. Forsyth patented a percussion powder for priming,[18] and, in 1814, Thomas Shaw of Philadelphia invented a steel percussion cap, substituting for it a copper one in 1816.[19]

It was this cap which made the percussion musket and rifle possible. Yet, in England, it was not until 1834 that experiments were made with the percussion system. In 1839, these led to the conversion of flintlock muskets to the percussion principle.[20]



The next improvement came in 1823. That year Captain Norton of the British 34th Regiment designed a cylindro-conoidal bullet with a hollow base, so that when fired it would automatically expand and seal the bore.[21] In 1836, Greener, a gunsmith, improved upon this bullet by inserting a conical wooden plug in its base. Though both inventions were rejected by the British Government, the idea was taken up in France, and, in 1849, working on Greener's design, M. Minié produced the Minié bullet. Thereupon it was adopted[22] by the British Government, and a rifle of the Minié pattern was issued to the army in 1851.

This rifle was first used in the Kaffir War of 1852, during which it was dis-

covered that "at a range of from twelve to thirteen hundred yards small bodies of Kaffirs could be dispersed."[23]

These two inventions—the percussion cap and the cylindro-conoidal bullet—revolutionized infantry tactics. The first rendered the musket serviceable in wet weather, reducing misfires in each 1,000 rounds from 411 to 4.5 and raising hits from 270 to 385 in 1,000 shots; the second caused the rifle to become the most deadly weapon of the century.

Yet another development springing from the percussion cap must be noted. It made possible the expansive cartridge case which, in turn, rendered practicable the breech-loading system.[24] This case completely revolutionized the art of gunnery by preventing the escape of all gases at the breech. First came Houiller's (a Paris gunsmith) pin-fire cartridge in 1847; next the rim-fire cartridge; and lastly Daw's central-fire cartridge case in 1861.

While these changes were in progress, steam propulsion, in the forms of the marine engine and the locomotive, was laying the military foundations of an intensified power politics which in the twentieth century was to disrupt the world. The one enabled Great Britain to extend her dominion of the seas; the other enabled first Prussia and later on all the Continental powers to put Clausewitz's theories into practice. I will now examine these in turn.

AS we have seen, the paddle wheel—known since the days of the Romans and experimented with during the sixteenth and seventeenth centuries—was first adapted to steam propulsion toward the end of the eighteenth century. In 1813, Robert Fulton, an American engineer of vision, built the first steam-propelled armored ship, the DEMOLOGOS, later renamed the FULTON. She was of twin-hull construction with a central paddle wheel between the hulls, and was protected by a belt of timber fifty-eight inches in thickness. This monstrous vessel clearly showed that two things were required: a less vulnerable system of propulsion, and a less clumsy means of protection.

The first of these problems was solved by the introduction of the screw propeller, for which, in 1836, patents were taken out in London by F. P. Smith and Capt. John Ericsson (a Swedish military officer). The second was solved by the substitution of iron for wood, the first iron vessel—a pleasure boat—had already been built in England in 1815.[25]

THIS is the fifth in a series of articles being written for ARMY ORDNANCE by General Fuller, well-known British soldier-author, on the development of weapons through the years and their influence on the course of civilization. In this article General Fuller traces the evolution of the strategy and tactics of warfare from the Industrial Revolution in the eighteenth century to the wars of the latter half of the nineteenth, showing the changes wrought in combat by the steamboat, the locomotive, improved metallurgy, and power-driven machinery.

The first article, "Armament and World History," appeared in the July-August 1944 issue; the second, "The Age of Valor," in the September-October number; the third, "The Age of Chivalry," in November-December; and the fourth, "The Age of Gunpowder," in the January-February 1945 issue. The next installment, "The Age of Oil," will appear in ARMY ORDNANCE for May-June.—EDITOR.

Strange to say, the British Admiralty was opposed to these "new-fangled" ideas. For instance, when in 1828 the Colonial Office asked Lord Melville, First Lord of the Admiralty, for a steam packet to convey mails from Malta to the Ionian Islands, the following reply was received: "Their lordships felt it their bounden duty to discourage, to the utmost of their ability, the employment of steam vessels, as they considered that the introduction of steam was calculated to strike a fatal blow at the naval supremacy of the Empire."[26]

What is so astonishing is that the shell gun, particularly the Paixhans gun,[27] had, since 1821, rendered the wooden ship so vulnerable as to deprive her of nearly all her fighting power. Paixhans saw this clearly, and, as Sir William Congreve had done in 1805, the following year he suggested that warships should be belted with iron plates.

At the very opening of the Crimean War, this prevision was justified, for at the Battle of Sinope, in 1854, a squadron of Turkish frigates was almost blown out of the water by the shellfire of the Russian ships.[28] The upshot was that immediately after France entered the conflict, Napoleon III issued an order for the construction of a flotilla of floating batteries protected by armor which would resist not only solid shot but also explosive shell. Five were built, protected by four inches of iron plate. They mounted sixteen 56-pounder shell guns and were equipped with auxiliary steam machinery. Their success was complete. Not only was the need for the armoring of ships proved beyond all doubt but also that armoring would necessitate the introduction of more powerful ordnance. This led to the general adoption of rifled cannon.

SHORTLY after the Crimean War ended, France and Great Britain laid down the first two armored steam warships, LA GLOIRE and the WARRIOR. These vessels were launched in 1859 and 1861. The WARRIOR was 380 feet in length; displacement, 8,830 tons; engine, 6,000 initial horsepower; speed, 14½ knots. Her armament consisted of twenty-eight 7-inch, 6½-ton guns, and her armor belt was 4½ inches in thickness.[29]

At length, on March 9, 1862, during the American Civil War, came the first trial between ironclads. That day, in Hampton Roads, the Confederate MERRIMAC met the Federal MONITOR,[30] and for three hours they pounded and rammed each other without a decision being gained. Nevertheless, this action proved decisive. Henceforth it was clear that no wooden ships could stand up to an ironclad. And of this engagement the British Admiral Sir John Hay said: "The man who goes into action in a wooden ship is a fool, and the man who sends him there is a villain."[31] Metaphorically, on March 9, 1862, the wooden fleets of the world were sunk in Hampton Roads.

Instead of striking a fatal blow at the naval supremacy of Great Britain, once a turnover from sail to steam became imperative her superior industrial power enabled her dockyards to outstrip those of the next two greatest naval powers combined. This would not have been practicable had the wooden ship continued, for already in 1839 the combined fleets of France and Russia were superior to her own.[32] What was most fortunate for her was that this change occurred before and during, instead of after, the locomotive had placed Prussia in a supremely powerful position on the continent of Europe.

It is no coincidence that the nation which produced Clausewitz was the first to grasp the supreme importance of the railway in war. Friedrich List (1789-1846), an economist of unique

genius, pointed out that from the position of a secondary military power, whose weakness lay in her central position between powerful potential enemies, Prussia could be raised by the railway to that of a formidable one. "She could be made into a defensive bastion in the very heart of Europe. Speed of mobilization, the rapidity with which troops could be moved from the center of the country to its periphery, and the other obvious advantages of 'interior lines' of rail transport would be of greater relative advantage to Germany than to any other European country."[33]

List himself wrote: "Every mile of railway which a neighboring nation finishes sooner than we, each mile more of railway it possesses, gives it an advantage over us. . . . It is just as little left in our hands to determine whether we shall make use of the new defensive weapons given us by the march of progress as it was left to our forefathers to determine whether they should shoulder the rifle instead of the bow and arrow."[34]

IN 1833, this remarkable man projected a network of railway lines for Germany which "is substantially that of the present Reichsbahnen,"[35] and thirteen years later, the year of his death, the first extensive troop movement by rail was made by a Prussian army corps, 12,000 strong, with horses and guns, to Cracow. This experimental move led to the Prussian General Staff making a survey of railways.

Though, during the revolutionary troubles of 1848-1850, Prussia gained further experience in rail movements, as also did Austria and Russia, it was not until the Italian War of 1859 and the American Civil War (1861-1865) that troop movements by rail may be said to have become normal. Next, in the Austro-Prussian War of 1866, strategy was largely shaped by the respective railroad systems. Finally, in the Franco-Prussian War (1870-1871) in the hands of Count von Moltke (1800-1891) railway strategy was reduced to a fine art.

From 1866 onward, mass armies take the field. The long-service standing army progressively gives way to the short-service conscript. Quality is ousted by quantity, and war becomes the affair of the "average man." As the professional proficiency of the soldier declines, a higher efficiency is demanded of the officer both in leadership and in administration. Command becomes so complex that it largely passes out of the hands of the individual into those of an oligarchy—the General Staff, assisted by a Quartermaster General Staff, an Adjutant General's Staff, and an ever-increasing number of experts.

Nor does change end here, for the larger armies grow the more dependent do they become on industry to equip, arm, and supply them both in peace and war. Industry, the postal and telegraph systems, etc., are organized for war, for a nation in arms demands a nation of armorers and technicians to sustain and maintain it. The nation which makes the greatest use of peace intervals to advance its mechanical and engineering potentials for war and which possesses the greatest number of skilled workers as well as of trained soldiers, and the most abundant supplies of raw materials as well as of arms, is the nation upon which victory smiles. In all this, Prussia took the lead as she also did in the development of the rifle, *par excellence* the weapon of the conscript mass army.

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While other nations were arguing over the merits and demerits of the flint- and percussion-lock muskets, in 1841[36] Prussia took the bold step of issuing to certain regiments the Dreyse breech-loading rifle, better known as the "needle gun."

Though breech-loading rifles, as we have seen, were suggested by Benjamin Robins, Johann Nicholas Dreyse (1787-1867) was the first man to produce a serviceable one, which he did between the years 1824 and 1836. Though its effective range was considerably less than that of the Minié rifle, seven shots a minute could be fired with it instead of a maximum of two. Nevertheless, its main advantage lay not in rapidity of loading but in the fact that a breech-operated rifle can be loaded in the prone position.[37]

IN the development of artillery, Prussia was less progressive. Breech-loading and rifling of cannon were old as separate ideas,[38] and it would seem that combined they were first experimented with in England in 1745.[39] Next, exactly a hundred years later, an effective breech-loading 6.5-inch rifled gun was invented by Major Cavalli, a Sardinian officer, and a still more effective one by Baron Wahrendorff in 1846.

Nevertheless, neither Prussia nor any other country would face the cost of reëquipment, so experiments continued. Then came the war in the Crimea, during which a number of cast-iron muzzle-loading smoothbore 68-pounders and 8-inch guns were converted into rifled pieces.[40]

In the American Civil War the rifled gun came more and more to the fore. Yet, from the armament point of view, the main characteristic of this war was the extraordinary inventiveness displayed throughout. During it a magazine-loading rifle and a machine gun were invented. Torpedoes, land mines, submarine mines, the field telegraph, lamp and flag signaling, wire entanglements, wooden wire-bound mortars, hand grenades, winged grenades, rockets, and many forms of booby traps were tried out. Armored trains were used; and balloons were employed by both sides. Explosive bullets are mentioned; searchlights, and "stink shell" to cause "suffocating effect" were asked for. The use of flame projectors was proposed, and the U. S. S. HOUSATONIC was sunk on February 17, 1864, by a small man-propelled Confederate submarine.[41]

"Just as the American War of Independence in the eighteenth century sounded the tocsin for the middle classes of Europe, so the American Civil War in the nineteenth century has sounded the tocsin for the European working class."[42]

Though the Austro-Prussian war of 1866 followed too closely for the American Civil War to be influenced by it, it showed little technical advance except in the superiority of the needle gun over the Austrian muzzle-loading Lorenz rifle. The Austrian tactics were completely obsolete, reliance being

placed on close formations and the bayonet.[43] Nevertheless, it is strange to learn that in this short war of seven weeks the Prussian expenditure of small-arms ammunition was only 2,000,000 rounds; that is, about 7 per man mobilized.

The importance of this war was that it increased Prussian man power by 24,000,000 people. This, bearing in mind the quantity theory, gave Prussia a mass superiority of thirty-three per cent over France. When the next clash came, as it did in 1870, this to a certain extent made good the deficiency between the now obsolescent needle gun and the French chassepot, which outranged it by several hundred yards.

Nevertheless, it was the superiority and handling of the Prussian breech-loading rifled guns over the French bronze muzzle-loading rifled cannon which was the decisive factor. At the Battle of Gravelotte, the Prussians had altogether no fewer than 726 such pieces. At Sedan—the decisive battle of the war—again the Prussians massed their guns, bringing all the French attacks to a standstill, and most of them at 2,000 yards' distance; that is, outside effective rifle range. At this battle "A French officer who was taken prisoner described the German fire as 'five kilometers of artillery.'"[44]

IN this war the field gun definitely challenged the dominance of the rifle, and in turn the rifle finally abolished cavalry as a shock arm; for a single volley was sufficient to shatter a charge, as happened to General Gallifet's Chasseurs d'Afrique at Sedan.[45] Nevertheless, the outstanding lesson of the war was that a conflict of masses is a war of accidents in which genius is out of place. Though the general can still plot and plan, and increasingly must do so, he can no longer lead or command because the masses are too vast for his grasp. Command now passes to the general staff, its foremost problem being the development of firepower. Thus the phalangial order—shock by bullets and shells—once again becomes supreme.

Though the European peace which followed the Franco-Prussian War was actually the longest in modern history,[46] no period since the Mongol invasions was so aggressive and none since the Industrial Revolution so progressive in the development of armament. In the generation following that war, Great Britain acquired 4,754,000 square miles of territory; France, 3,583,580; Germany, 1,026,220; and Belgium, 900,000 square miles—79 times her own size!

These enormous annexations, rendered possible by the breech-loading rifle, as those of the Conquistadores had been by the arquebus, so influenced international politics and trade that, in order to secure commercial predominance, an armament race was fostered. This was led by Germany, who, in 1898, set out to establish herself as the second greatest naval power—a challenge to the maritime supremacy of Great Britain.

During this period, naval construction developed so rapidly that warships passed into obsolescence no sooner than they were launched. Three new weapons, old in idea, revolutionized naval tactics; namely, the submarine mine, the torpedo, and the submersible ship.

The first had been used by the Americans as early as 1777; but it was not until electrically fired mines were introduced during the American Civil War that this weapon became really effective.

The second, in the form of the spar or outrigger torpedo, had been experimented with by Fulton in 1805 and was used during the American Civil War. It was followed by the Harvey, Lay, Sims-Edison, and Brennan locomotive torpedoes, the first three electrically steered by a wire trailing behind.

All these were superseded by the self-propelled Whitehead torpedo, which, in turn, led to the introduction of the torpedo boat.

The third was the submarine, or submersible torpedo carrier, first successfully experimented with by David Bushnell in 1775.[47] It was not, however, until 1875 that J. P. Holland designed the first practical submarine, which, in 1883, was followed by the Nordenfeldt model, a vessel of sixty tons, with a submerged speed of nine knots. Thence onward evolution was rapid. Nevertheless, not until the opening years of the twentieth century was this type of warship generally adopted.

On land, military progress was equally intense. The theory of the nation in arms was now finally accepted by all Continental powers and also by Japan. In turn, the powers of conscript armies were vastly fortified by three developments in armament—the general adoption of the small-bore magazine rifle firing smokeless powder, the perfection of the machine gun, and the introduction of quick-firing artillery.

THE first came into general use between 1886 and 1891. The second, as we have seen, was a very old idea, dating back to the ribaudequin of the fourteenth century. In modern form it first appeared in the shape of the Gatling gun during the American Civil War.[48] This was a 10-barrel revolving rifle. In 1866 the French mitrailleuse or *canon à balle* was invented by Commandant Reffye. It had 25 barrels and could fire at a maximum rate of 125 rounds a minute. But it was not until 1884 that Hiram S. Maxim produced an automatic gun of real value,[49] a weapon destined to revolutionize small-arms tactics.

The third, which was to reëstablish the gun as the dominant weapon, was evolved from the proposals put forward in 1891 by General Wille in Germany and Colonel Langlois in France. Their main suggestion was that high rate of fire was impossible unless recoil on firing was absorbed. This led to much experimental work on shock absorption and to the eventual introduction of a nonrecoiling carriage. This carriage permitted of a bulletproof shield being attached to it to protect the gun crew. Thus armor was once again introduced.

Until this improvement in artillery was made, the magazine rifle, on account of its range, volume of fire, and portability, as well as the invisibility of the firer using smokeless powder, was the dominant weapon. Now it was challenged by the quick-firing gun,

LOOKING back on this period, the outstanding fact is the emergence of a new feudal order in which the great financial, industrial, and commercial interests take the place of the medieval barons. It is a society based on manufacture more so than on agriculture, the driving force of which is steam power and not religion. The common factor linking these two social systems is not so much war as preparation to wage it. As from the field lands came the earliest weapons, the latest now come from the factories. Throughout both periods it is war that shapes peace and armament that shapes war.

WHILE these changes were in progress, steam propulsion, in the forms of the marine engine and the locomotive, was laying the military foundations of an intensified power politics which in the twentieth century was to disrupt the world. The one enabled Great Britain to extend her dominion of the seas; the other enabled first Prussia and later on all the Continental powers to put Clausewitz's theories into practice.

which not only outranged it and could be fired with equal rapidity but which, by indirect laying, could also be rendered invisible.

DURING the Russo-Japanese War (1904-1905), this dominance became apparent to at least one eyewitness, Maj. J. M. Home, who, in one of his reports, wrote: "The great impression made on me by all I saw is that artillery is now the decisive arm and that all other arms are auxiliary to it. The importance of artillery cannot be too strongly insisted upon, for, other things being equal, the side which has the best artillery will always win. . . . So strongly am I convinced of the immense importance of artillery that it seems almost a question for deliberate consideration whether artillery should not be largely increased even at the expense of the other arms . . ." [50]

Thus do we see the gun gaining supremacy over the rifle as the rifle had gained supremacy over the nonrecoil gun. New tactics were in the making which were destined to change the character of war and with it the course of history.

Looking back on this period, the outstanding fact is the emergence of a new feudal order in which the great financial, industrial, and commercial interests take the place of the medieval barons. It is a society based on manufacture more so than on agriculture, the driving force of which is steam power and not religion. The common factor linking these two social systems is not so much war as preparation to wage it. As from the field lands came the earliest weapons, the latest now come from the factories. Throughout both periods it is war that shapes peace and armament that shapes war.

Lewis Mumford shows that it was the quantity idea underlying the conception of the nation in arms, and more still the quantity needs of such a society, that fostered industry. The massing of men for war demanded the massing of money to pay for them and the massing of manufacture to equip them. As he writes: "In terms of the barracks, the routine of the factory seemed tolerable and natural. The spread of conscription and volunteer militia forces throughout the Western world after the French Revolution made army and factory, so far as their social effects went, almost interchangeable terms." [51] As an example he notes that, in 1888, Bellamy "took the organization of the army on a basis of compulsory service as the pattern of all industrial activities." [52]

Military needs not only stimulated output and adventure, but also frequently created new industries. Thus, Napoleon I offered a large prize to any one who discovered a practical way of preserving field rations. "It was won by Nicholas Appert, who, though he used glass containers, may justly be said to have been the father of the canning industry." [53]

Similarly, in the middle of the nineteenth century, Napoleon III offered a reward for "a cheap process of making steel capable of withstanding the explosive force of the new shells. The Bessemer process was the direct answer to this demand." [54]

GUN CASTING improved foundry technique, and the demand for high-grade iron went hand in hand with the increase in artillery bombardments and the armoring of warships. Railways were built for strategic purposes, harbors as naval bases, and colonies were conquered to guarantee stocks of war-like raw materials.

"The state of paleotechnic society," writes Mumford, "may be described, ideally, as one of wardom. Its typical organs, from mine to factory, from blast furnace to slum, from slum to battlefield, were at the service of death. Competition: struggle for existence: domination and submission: extinction. With war at once the main stimulus, the underlying basis, and the direct destination of this society, the normal motives and reactions of human beings were narrowed down to the desire for domination and to the fear of annihilation. . . . The mine and the battlefield underlay all the paleotechnic activities; and the practices they stimulated led to the widespread exploitation of fear." [55]

But what kind of war did fear create? A war on all fronts—diplomatic, social, economic, and psychological as well as military. This was foreseen by Engels and Marx who, as Mr. Earle points out, "can rightly be called the fathers of modern total war." [56] To them," he writes, "war was fought with different means in different fields. In the words of the later militant syndicalist Georges Sorel, a general strike could become a 'Napoleonic battle,' just as the Crimean War could be regarded as a prelude to a great international civil strife." [57] They were the apostles of the maturing wardom which was to engulf Christendom by unchaining mass man.

Who held the leash of this Hydra-headed monster? Not kings, nor presidents, nor cabinets, nor parliaments; instead the giant financial interests.

TWO generations later, Moltke's outlook was much the same. He wrote:

"Nowadays, the Bourse has assumed such influence that it has the power to call armies into the field merely to protect its interests. Mexico and Egypt have been swamped with European armies simply to satisfy the demands of the *haute finance*. Today the question, 'Is a nation strong enough to make war?' is of less importance than that, 'Is a government powerful enough to prevent war?' " [58]

Later on came Foch, who was still more emphatic. Lecturing to the students of the French Staff College on "The Primal Characteristics of Modern War," he said:

"The means for a nation to obtain wealth and satisfy its cravings is found in waging war. . . . The German victories of 1870 have enriched the individual German. Every German has a *share in the profits,* and is directly interested *in the firm, in the constitution, and in victory. That is what is now meant by a people's war.*"

He points to the Chinese and Japanese War of 1894, the Spanish-American War, and the Franco-British quarrel over Fashoda, and then writes: "What were we all seeking? For commercial outlets to an industrial system which produces more than it can sell. . . . Who was responsible for the Boer War? Certainly not the Queen of England, but the merchants of the City." [59]

Yet, what neither Moltke nor Foch saw was that the growing interdependence of the industrial world was rapidly transforming war as a profitable busi-

ness into a mad kind of burglary—the plundering of one's *own* house. One man, however, did see this—not a soldier but a banker, a Polish Jew—I. S. Bloch, who, in 1897 published a 3-volume work entitled, "The War of the Future in Its Technical Economic and Political Relations."[60]

"What is the use," wrote Bloch, "of talking about the past when you are dealing with an altogether new set of considerations? Consider for one moment what nations were a hundred years ago and what they are today. In those days before railways, telegraphs, steamships, etc., were invented each nation was more or less a homogeneous, self-contained, self-sufficing unit. . . . All this is changed. . . . Every year the interdependence of nations upon each other for the necessities of life is greater than it ever was before. . . . Hence the first thing that war would do would be to deprive the powers that made it of all opportunity of benefiting by the products of the nations against whom they were fighting. . . . The soldier is going down and the economist is going up." Therefore war is no longer a profitable court of appeal.

"The outward and visible sign of the end of war," he wrote, "was the introduction of the magazine rifle. . . . The soldier by natural evolution has so perfected the mechanism of slaughter that he has practically secured his own extinction."

HIS description of the modern battle is exact, for it is exactly as it was fought seventeen years later. And his prediction of the coming war is no less so:

"At first there will be increased slaughter—increased slaughter on so terrible a scale as to render it impossible to get troops to push the battle to a decisive issue. . . . The war, instead of being a hand-to-hand contest in which the combatants measure their physical and moral superiority, will become a kind of stalemate in which, neither army being able to get at the other, both armies will be maintained in opposition to each other, threatening each other, but never able to deliver a final and decisive attack. . . . That is the future of war—not fighting, but famine; not the slaying of men, but the bankruptcy of nations and the breakup of the whole social organization. . . . Everybody will be entrenched in the next war. It will be a great war of entrenchments. The spade will be as indispensable to a soldier as his rifle. All wars will of necessity partake of the character of siege operations. . . . Soldiers may fight as they please; the ultimate decision is in the hands of *famine* . . ."

All these things emerged from out of a cloud of steam. If this is not magic —what is? Nevertheless, Bloch overlooked one item: man is eternally inventive. No sooner does he bring a system of destruction to perfection than the constant tactical factor—the urge to eliminate the danger he has created—under the whip of disaster compels him to seek yet another. The steam age in war had reached its further shore, and as Bloch's prophecy was about to be fulfilled, already in the distance gleamed yet another unexplored sea—the ocean of the Age of Oil.

THAT is the future of war—not fighting, but famine, not the slaying of men, but the bankruptcy of nations and the breakup of the whole social organization . . . Everybody will be entrenched in the next war. It will be a great war of entrenchments. The spade will be as indispensable to a soldier as his rifle. All wars will of necessity partake of the character of siege operations . . . Soldiers may fight as they please; the ultimate decision is in the hands of *famine*.

REFERENCES

[1] "Wealth of Nations," 1904, p. 457. Alexander Hamilton held the same opinion. (See No. 6 of *The Federalist.*)

[2] "The Law of Civilization and Decay," 1921, pp. 313-314.

[3] See also his remarks on breaking away from conventional tactics, "Œuvres Militaires de Guibert," 1803, Vol. II, p. 253.

[4] For the increase of light troops during this war, see my "British Light Infantry in the Eighteenth Century," 1925.

[5] "Writings of Washington," Vol. IV, pp. 406, 557.

[6] "The French Revolution," Albert Mathiez, 1928, p. 485.

[7] *Ibid.*, p. 482.

[8] "History of the British Army," Hon. J. W. Fortescue, Vol. IV, p. 294.

[9] Vol. VI, p. 972.

[10] "Life of Sir Robert Wilson," H. Randolph, 1862, Vol. I, p. 86.

[11] "Journals and Correspondence of Sir Harry Calvert," 1853, p. 220.

[12] See my "British Light Infantry in the Eighteenth Century" and Sir John Moore's "System of Training," 1925.

[13] Quoted by Crane Brinton, Gordon A. Craig, and Felix Gilbert in "Makers of Modern Strategy," 1943, pp. 91-92.

[14] "The Decline of the West," 1922, Vol. II, pp. 428-429.

[15] "On War," Carl von Clausewitz, 1908, Vol. I, pp. 1, 4, 121; Vol. II, p. 231; Vol. III, p. 121.

[16] In Great Britain the first successful attempt to apply the steam engine to the paddle wheel was made in 1785. In 1775, James Rumsey, a Virginian, carried out the first practical trials of water-jet propulsion on the Potomac: a steam pump sucked in water at the bow and threw it out at the stern.

[17] The SAVANNAH was 130 feet long; displacement, 1,850 tons; gross tonnage, 320; knots, 6. She was fitted with paddles and took twenty-five days to sail from Savannah, Ga., to Liverpool, Eng.

[18] The explosive he used was a mixture of chlorate of potash, sulphur, and charcoal, later changed to chlorate of potash, fulminate of mercury, and powdered glass.

[19] Col. Peter Hawker also invented a copper percussion cap in 1818 ("Instructions to Young Sportsmen," Col. Peter Hawker, 11th ed., 1859, p. 76). There are many other claimants.

[20] The advantage of this may be judged from the following incident: "A company of Sepoys, armed with flintlock muskets, which would not go off in a heavy rain, were closely surrounded by some thousand Chinese and were in imminent peril, when two companies of marines, armed with percussion-cap muskets, were ordered up and soon dispersed the enemy with great loss" (Dispatch of Lieut. Gen. Lord Viscount Gough, *London Gazette,* October 8, 1841).

[21] "The idea came to him from an examination of the arrow used by the natives of Southern India with their blowtube: An examination which revealed that the base of the arrow was formed of elastic lotus pith, which by its expansion against the cylindrical surface of the tube prevented the escape of air past it" ("The Evolution of Naval Armament," Frederick Leslie Robertson, 1921, p. 193).

[22] In 1852, the British Government paid M. Minié £20,000 for his bullet, and in 1857 Greener received £1,000 for having given him the idea!

[23] "A History of the British Army," J. W. Fortescue, 1927, Vol. XII, p. 180. Rifles, as military weapons, would appear first to have been used in 1631 by the Landgrave of Hesse; but it was not until the War of American Independence that their value became clear.

[24] The breech-loading principle was an old idea. The range of the needle gun was short. A paper cartridge was used and escape of gas at the breech was considerable.

[25] Iron canal barges had appeared in England during the late eighteenth century.

[26] "Journal of the Royal United Service Institution," London, 1931, Vol. LXXVI, No. 502, p. 258. In 1834, Admiral Lord Dundonald wrote: "Give me a fast small steamer with a heavy long-range gun in the bow and another in the hold to fall back upon, and I would not hesitate to attack the largest ship afloat. . . . As large a gun as possible in a vessel as small and swift as possible, and as many of them as you can put upon the sea" ("The Autobiography of a Seaman—Thomas, Tenth Earl of Dundonald," 1890, p. 546).

[27] Gen. Henri Joseph Paixhans (1783-1854) was a noted French artillerist. His gun was adopted by the French Government in 1827.

[28] Except for one small steamer, every one of the Turkish vessels was destroyed. "It was believed by men in authority that 4,000 Turks were killed, that less than 400 survived, and that all these were wounded" ("The Invasion of the Crimea," A. W. Kinglake, Student's Edition, 1899, p. 63).

[29] In 1910 the WARRIOR was converted into a floating workshop and was renamed VERNON III. The armor of LA GLOIRE was five inches thick and backed by twenty-six inches of wood.

[30] The MONITOR was designed by Ericsson. It was of 1,200 tons' displacement; upper hull, 174 feet long; low speed; 3 to 5 inches of armor on 27 inches of wood backing. It had a single revolving turret carrying two 11-in. Dahlgren smoothbore guns protected by 8-inch armor. The MERRIMAC (VIRGINIA) was a cut-down wooden vessel of 3,500 tons' displacement, 175 feet long with a sloping roof of 24 inches of wood covered with 4-inch armor. She mounted 10 guns and had a maximum speed of 5 knots. It took a full half hour to turn her around.

[31] Quoted by Robertson in "The Evolution of Naval Armament," p. 263.

[32] Great Britain: 90 ships of the line, 93 frigates, and 12 steamers. Russia and France: 99 ships of the line, 85 frigates, and 45 steamers.

[33] Edward Mead Earle in "Makers of Modern Strategy," 1943, p. 149.

[34] *Ibid.*, pp. 150-151.

[35] *Ibid.*, p. 149.

[36] This rifle was steadily improved, and the whole Prussian Army was armed with it between 1853-1858 ("Geschichte der Infanterie," W. Rüstow, 1884, Vol. II, p. 375). It was bolt-operated, and the 1841 model was sighted to 650 yards and was of .607-in. caliber.

[37] On June 29, 1866, during the attack on Königinhof, a captured Austrian officer said to Colonel Kessel: "Our soldiers are demoralized not by the rapidity of your fire, for we could find some means perhaps to counterbalance that, but because you are always ready to fire" ("Military Reports," Col. Baron Stoffel, French military attaché in Prussia, 1866-1870, English edition, 1872, p. 64).

[38] Breech-loading ordnance dates from about the end of the fourteenth century. A rifled cannon with thirteen shallow grooves was experimented with in Prussia in 1661, and another in 1696 with elliptical bore—similar to the Lancaster of 1854—was tried out in Germany. In 1836 a number of experiments were made in Russia with a Belgian rifled gun—the Montigny—but were not very successful.

[39] "Tracts of Gunnery," Benjamin Robins, p. 337.

[40] "In this principle the rotation of the shell was achieved not by grooves in the bore of the gun, but by the shape of the bore which was oval and made one turn in 360 inches" ("The Story of the Gun," Lieut. A. W. Wilson, 1944, p. 47).

[41] For these and other inventions see my "War and Western Civilization, 1832-1932," 1932, pp. 97-99; also "Meade's Headquarters, 1863-1865," Col. Theodore Lyman, 1922, p. 284; "Makers of Modern Strategy," p. 289; and Spengler's "The Decline of the West," 1928, Vol. II, p. 421.

[42] "Capital," Everyman's Library, 1930, Vol. II, p. 864.

[43] Reliance on the bayonet was the tactical obsession of the nineteenth century. General Jomini, who fought in the Napoleonic Wars and died in 1869, "is said to have remarked that, though he had seen a position taken at shoulder arms, he had never actually witnessed a charge with the bayonet, let alone taken part in one" ("Makers of Modern Strategy," p. 82).

[44] "Decisive Battles since Waterloo, 1815-1887," Thomas W. Knox, 1887, p. 358. "The ideal battle of cannon was never so nearly approached as on that day" (Col. Chesney in *Edinburgh Review*, April 1871, p. 563).

[45] "My Experiences of the War between France and Germany," Archibald Forbes, 1871, Vol. I, p. 236.

[46] Excepting the Russo-Turkish War of 1877-1878, the Greco-Turkish War of 1897, the Italo-Turkish War, and Balkan Wars of 1911-1913—all localized conflicts—no general war occurred until 1914.

[47] Bushnell's submarine was worked by one man. During the War of Independence, his vessel, shaped like a turtle, dived beneath the British warship EAGLE, and the operator attempted to drive his torpedo, which was provided with a spiked screw, into her bottom. Through an error of judgment he failed to do so. In 1801, Fulton built two submarines for France which could remain under water four hours.

[48] Jomini in his "The Art of War," Philadelphia, 1868, p. 48, mentions "the Perkins steam guns, which vomit forth as many balls as a battalion."

[49] Other machine guns of this period were the Gardner, Nordenfeldt, Hotchkiss, and Colt.

[50] "The Russo-Japanese War, Reports from British Officers," 1908, Vol. III, p. 202.

[51] "Technics and Civilization," 1934, p. 84.

[52] *Ibid.*, pp. 190-191.

[53] "First Canned Rations," W. B. Chivers, British Canning Industry Number, *The Times*, November 17, 1931.

[54] "Technics and Civilization," Lewis Mumford, p. 91.

[55] *Ibid.*, p. 195.

[56] "Makers of Modern Strategy," 1943, p. 156.

[57] *Ibid.*, p. 156.

[58] "The Franco-German War of 1870-1871," English edition, 1891, Vol. I, p. 2.

[59] "The Principles of War," English edition, 1918, pp. 36-37.

[60] An abbreviated English edition appeared in 1899 under the title "Is War Now Impossible?"

The Research Board

A New Body for National Security

ESTABLISHMENT of the Research Board for National Security by the National Academy of Sciences was announced recently in a joint statement by the Hon. Henry L. Stimson, Secretary of War; the Hon. James Forrestal, Secretary of the Navy; and Dr. Frank B. Jewett, president of the National Academy of Sciences. In requesting the president of the National Academy of Sciences, under its congressional charter, to establish this board, the Secretaries of War and Navy said:

"A recommendation from the Committee on Postwar Research has been received for the establishment by Congress of an independent agency to deal with the matter, but, pending action on this recommendation and to assist in providing for continued civilian participation in the longer-term scientific problems of national security, when the Office of Scientific Research and Development proceeds to liquidate its activities as a temporary wartime agency, the National Academy of Sciences is hereby requested to establish promptly within the National Academy of Sciences a Research Board for National Security."

The objective of the board will be to continue, pending final consideration by Congress on creation of an independent agency, the close coöperation between civilian scientists and the armed services which has proved to be such a vital element in the prosecution of the war.

COMPOSED of high-ranking officers responsible for the needs and plans of the Army and Navy, together with an equal number of distinguished representatives of science, engineering, medicine, and industry, this board includes many of the features of the Office of Scientific Research and Development, which has been so successful as a wartime agency in mobilizing civilian scientists and coördinating their work with the requirements and operations of the armed services.

The Secretaries of War and Navy said in part: "This war emphasizes three facts of supreme importance to national security. (1) Powerful new tactics of defense and offense are developed around new weapons created by scientific and engineering research. (2) The competitive time element in developing those weapons and tactics may be decisive. (3) War is increasingly *total* war, in which the armed services must be supplemented by active participation of every element of the civilian population."

THE charter of the new board provides for up to twenty civilians selected with the advice of the chairman of the National Research Council and the Council of the National Academy of Sciences; also up to ten high-ranking officers each from the Army and the Navy, nominated by the respective Secretaries—all to be appointed by the president of the Academy. Five members of this board constitute its executive or operating committee; three of the five are civilians, of whom one is chairman of the board and the executive committee. The two Army and Navy members are officers charged, in their respective Departments, with coördination of research. The members of the board serve as such without compensation. The research activities are to be carried out under contracts whereby existing laboratories and facilities will be used wherever practicable.

The duties of the board are specified in its charter as follows:

"It shall be the duty of the board to formulate programs of scientific research and development relative to problems of national security, to direct and conduct the scientific study of such problems, and to advise the Secretary of War and the Secretary of the Navy on the applications of science to national security. Science is here broadly interpreted to include the employment of scientific method of analysis, experiments and tests in any branch of science or technology, including engineering, medicine, psychology, and biology. Special consideration shall be given to possibilities arising from progress in science and technology. The board shall in no way relieve the Army or Navy or other governmental agencies of their responsibility for, or authority over, research and development work conducted under their legal cognizance."

The initial membership of the board is shown in the adjoining column.

MEMBERSHIP OF THE RESEARCH BOARD

Executive Committee

Karl T. Compton *(Chairman)*, president, Massachusetts Institute of Technology; **Roger Adams,** head, Department of Chemistry, University of Illinois; **A. R. Dochez,** Professor of Experimental Medicine and Surgery, College of Physicians and Surgeons, Columbia University; **Brig. Gen. W. A. Borden,** director, New Developments Division, War Department Special Staff; **Rear Adm. J. A. Furor,** Coördinator of Research and Development, Navy Department.

Army

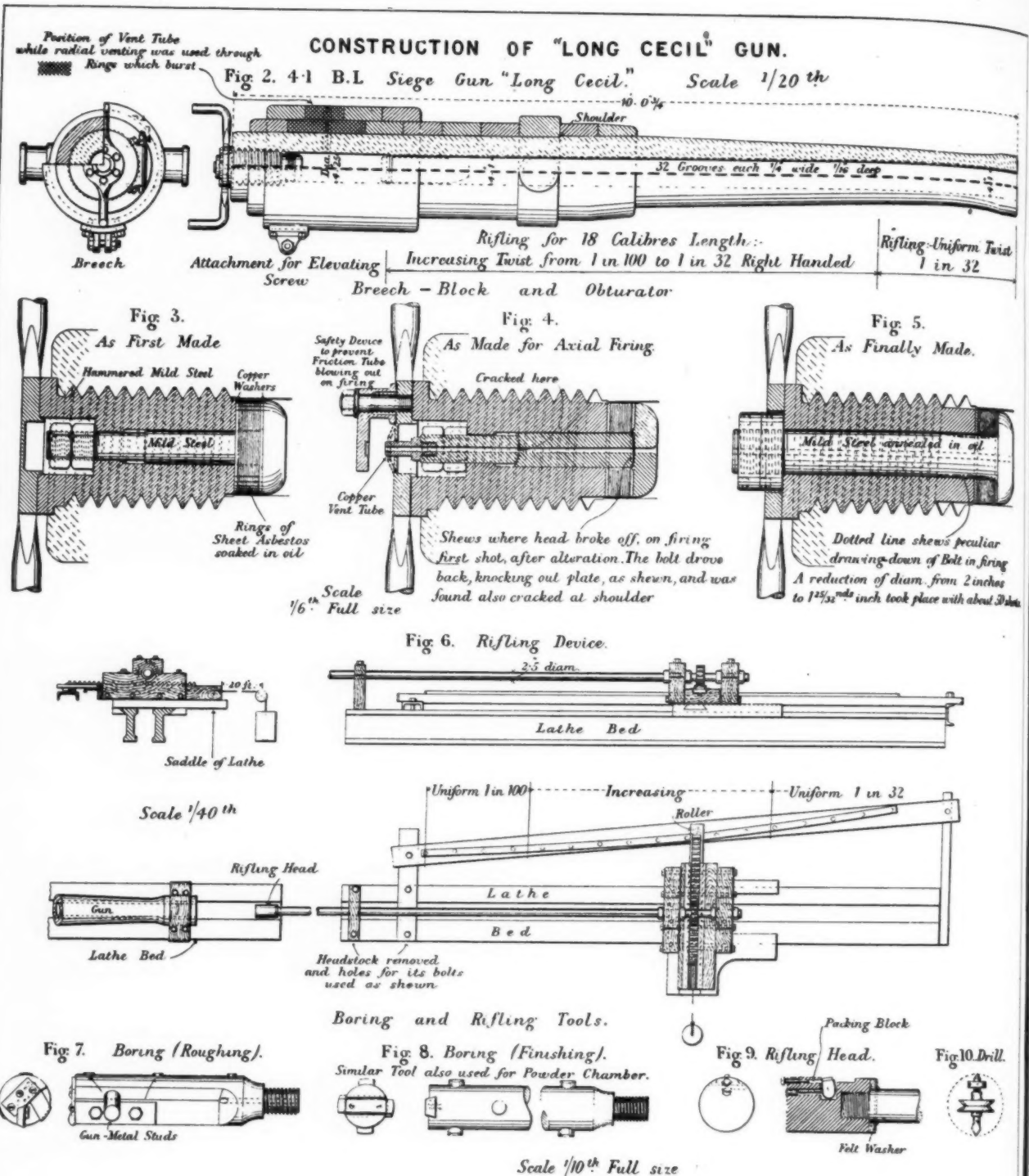
Dr. E. L. Bowles, special consultant to the Secretary of War; **Maj. Gen. Levin H. Campbell, Jr.,** Chief of Ordnance; **Lieut. Gen. B. M. Giles,** Chief of Air Staff, Army Air Forces; **Maj. Gen. John E. Hull,** Chief of Operations, War Department General Staff; **Maj. Gen. Harry C. Ingles,** Chief Signal Officer; **Maj. Gen. Norman T. Kirk,** Surgeon General of the Army; **Maj. Gen. William N. Porter,** Chief, Chemical Warfare Service; **Maj. Gen. Wilhelm D. Styer,** Chief of Staff, Army Service Forces; **Maj. Gen. Albert W. Waldron,** Chief, Requirements Section, Army Ground Forces.

Navy

Vice Adm. Frederick J. Horne, Vice-Chief of Naval Operations; **Vice Adm. Ross T. McIntire,** Chief, Bureau of Medicine and Surgery; **Vice Adm. Ben Moreell,** Chief, Bureau of Yards and Docks; **Rear Adm. H. G. Bowen,** special assistant to the Secretary of the Navy; **Rear Adm. W. J. Carter,** Assistant Chief, Bureau of Supplies and Accounts; **Rear Adm. E. L. Cochrane,** Chief, Bureau of Ships; **Rear Adm. W. S. DeLany,** Assistant Chief of Staff, Readiness, Cominch; **Rear Adm. George F. Hussey, Jr.,** Chief, Bureau of Ordnance; **Rear Adm. DeWitt C. Ramsey,** Chief, Bureau of Aëronautics.

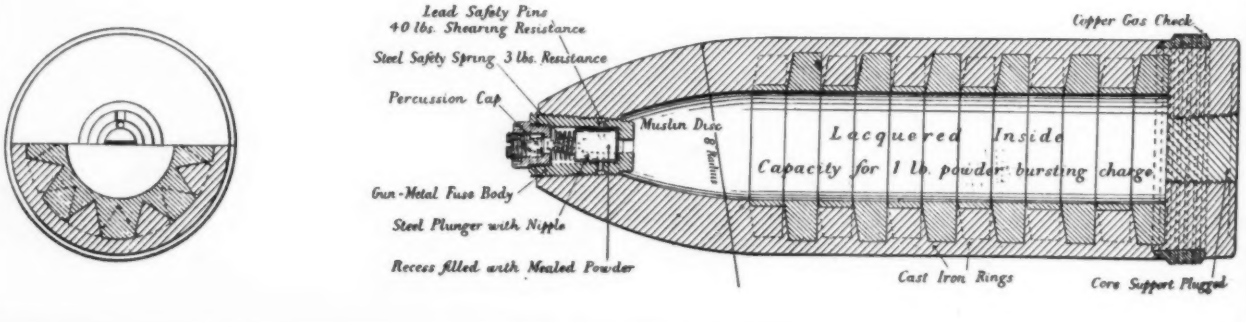
Civilian

E. K. Bolton, chemical director, E. I. du Pont de Nemours & Company; **Oliver E. Buckley,** president, Bell Telephone Laboratories; **Bradley Dewey,** president, Dewey and Almy Chemical Company; **Lee A. DuBridge,** dean of the faculty of arts and sciences, University of Rochester, and director, radiation laboratory, National Defense Research Committee; **H. S. Gasser,** director, Rockefeller Institute for Medical Research; **A. Baird Hastings,** professor of biochemistry, Harvard University; **J. C. Hunsaker,** chairman, National Advisory Committee for Aëronautics, and professor of mechanical and aëronautical engineering, Massachusetts Institute of Technology; **W. S. Hunter,** professor of psychology, Brown University, and chief, applied psychology panel, National Defense Research Committee; **Zay Jeffries,** vice-president, General Electric Company; **C. C. Lauritsen,** professor of physics, California Institute of Technology; **E. O. Lawrence,** professor of physics, University of California; **Linus Pauling,** chairman, division of chemistry and chemical technology, California Institute of Technology; **H. W. Prentis, Jr.,** president, Armstrong Cork Company; **I. I. Rabi,** professor of physics, Columbia University; **Elvin C. Stakman,** professor of plant pathology, University of Minnesota; **Oswald Veblen,** Institute for Advanced Study; **Lewis H. Weed,** director, School of Medicine, Johns Hopkins University, and chairman, division of medical sciences, National Research Council.


CONSTRUCTION OF "LONG CECIL" GUN.
Position of Vent Tube while radial venting was used through Rings which burst
Fig 2. 4·1 B.L Siege Gun "Long Cecil." Scale 1/20th
10. 0¾
Shoulder
32 Grooves each ¼ wide 1/16 deep
Breech
Attachment for Elevating Screw
Rifling for 18 Calibres Length:- Increasing Twist from 1 in 100 to 1 in 32 Right Handed
Rifling Uniform Twist 1 in 32
Breech – Block and Obturator
Fig 3. As First Made
Hammered Mild Steel
Copper Washers
Mild Steel
Rings of Sheet Asbestos soaked in oil
Fig 4. As Made for Axial Firing
Safety Device to prevent Friction Tube blowing out on firing
Cracked here
Copper Vent Tube
Shews where head broke off, on firing first shot, after alteration. The bolt drove back, knocking out plate, as shewn, and was found also cracked at shoulder
Fig 5. As Finally Made.
Mild Steel annealed in oil
Dotted line shews peculiar drawing-down of Bolt in firing
A reduction of diam. from 2 inches to 1 25/32nds inch took place with about 30 shots
Scale 1/6th Full size
Fig 6. Rifling Device.
10 ft.
Saddle of Lathe
2·5 diam.
Lathe Bed
Scale 1/40th
Uniform 1 in 100
Increasing
Uniform 1 in 32
Roller
Rifling Head
Gun
Lathe Bed
Lathe Bed
Headstock removed and holes for its bolts used as shewn
Boring and Rifling Tools.
Fig 7. Boring (Roughing).
Gun-Metal Studs
Fig 8. Boring (Finishing).
Similar Tool also used for Powder Chamber.
Fig 9. Rifling Head.
Packing Block
Felt Washer
Fig 10. Drill.
Scale 1/10th Full size

Ring Shells made at the workshops of the D.B.C. Mines during the Siege of Kimberley, 1899-1900.

Fig 11. *For 4·1 inch B.L. Siege Gun "Long Cecil."*



Labram and the "Long Cecil"

A Tale of Yankee Ingenuity in the Defense of Kimberley

Col. Clarence E. Davies

When the Boers attacked Kimberley, South Africa, in 1899, the town was defended only by a battery of 2.5-inch muzzle-loading guns. George Labram, an American mining engineer, without previous experience in ordnance, designed and developed a 4-inch breech-loading cannon which helped repel the Boers throughout the siege.

GEORGE LABRAM, in a few years in South Africa, marked up a distinguished record of ingenuity and mechanical accomplishment. His most spectacular achievement was the building of the cannon "Long Cecil" during the siege of Kimberley in the Boer War. Without experience in cannon design, using the materials available in the diamond-mine shops, and depending on information in an encyclopædia and current periodicals, Labram in twenty-four days constructed a 4.1-inch gun that performed well in the defense of Kimberley.

Labram was born in the United States about 1863, his father having been an engineer in the copper mines of the Lake Superior district. After varied experiences in mining in this country and in Mexico, he went to Kimberley in South Africa in 1893 to install a crushing and concentration plant at the De Beers Consolidated Mines, Ltd., of which Cecil Rhodes was chairman and Gardner F. Williams, general manager. On the completion of the construction he took charge of the plant. Later he was made mechanical engineer of the company and in 1898 chief mechanical engineer.

Kimberley, a community of 50,000 in the midst of the diamond mines, was besieged on October 14, 1899. The facilities and labor of the mines were immediately called upon to prepare the town to withstand the siege. Labram was called on to build an emergency cold-storage plant for preserving the meat supplies. This he did in four days by insulating a small storehouse and installing a steam ice-making machine. The water supply was cut off by the Boers, and Labram made an emergency connection with a mine water supply which provided ample water throughout the siege.

The garrison of Kimberley consisted of five companies of infantry, a small unit of engineers, and a battery of artillery armed with six 2.5-inch 7-pounder muzzle-loading guns. The Boers possessed a 15-pounder, so it was apparent that successful defense required a more powerful weapon.

On Christmas Day, 1899, when it was apparent that the siege would be long drawn out, Mr. Rhodes directed the building of a bigger gun, and Labram started. The gun was finished on January 19, 1900, after twenty-four continuous days' work and was immediately tested and ranged. On January 23rd it was put into action. During the siege, 255 shells were fired at ranges of 5,000 to 6,000 yards.

The gun, the method of machining, and the ammunition are shown in the illustration (p. 258) taken from Mr. Goffe's paper (Figs. 2 to 11). Some additional information will be of interest. Fortunately, the diamond mines had a large stock of black powder of various grains which had been used for blasting in the open mines. Using information in the Encyclopædia Brittanica and current engineering periodicals, preliminary approximations led to the decision to build a gun of about 4-inch bore, shooting a projectile of from 25 to 30 pounds, and with a chamber powder pressure of about 50,000 pounds per square inch, using 5 pounds of powder.

A BILLET of shafting steel 10½ inches thick and 10 feet long was available. It had a "breaking strain of 27 to 30 tons per square inch, giving an elongation of 20 to 35 per cent in 8 inches and a 40 per cent reduction in area." This was turned, drilled, rough-bored to form the inner tube. To reduce the stress in the tube at the breech, breech rings were necessary. These were made from bars of 6 by 2½ inches Lowmoor iron (a high-grade wrought iron), formed, welded, turned, bored, and shrunk into place. Nine rings were put on next to the tube and four in the outer row were shrunk over the inner row at the breech. The trunnion block was forged in one piece from a block of 6-inch square Lowmoor iron and shrunk on the tube against a shoulder. The assembled tube was then finished. The caliber of the gun was 4.1 inches. The finished gun tube is shown in Fig. 2; the rifling tools in Figs. 6 through 10.

The breechblock (Fig. 3) was made of mild steel with a full-screw ¾-inch pitch V-thread.

THE shell, which weighed twenty-nine pounds, was made in both common and ring form. The ring form, shown in Fig. 11, was familiar to the shops which had previously made the smaller 7-pound size. This ingenious fragmentation type was made by placing cast-serrated rings on a clay core and casting the rest of the projectile over them.

As in all new devices, operating difficulties cropped up. One morning, firing a 6-pound charge in a cold gun, three breech rings burst (Fig. 2). The difficulty was diagnosed as gas leakage through the radial vent due to faulty welding. The rings were replaced, the radial vent plugged, and an axial vent was bored through the breechblock. The first shot after this alteration broke off the head of the obturator (Fig. 4). The next bolt made was oil-annealed and it served throughout the siege (Fig. 5).

"Long Cecil's" firepower caused much confusion among the Boers, and, as a countermeasure, a "Long Tom," firing a 95-pound shell was brought in by the Boers on February 8th. It continued firing during the next day, and the last shot of the day at about 6 P.M. crashed through the roof and three brick walls of the Grand Hotel into the room of George Labram, killing him. Labram was buried at night on the 10th, will full military honors, and the American Flag was draped over his coffin. On the 15th, the siege was lifted by a British column.

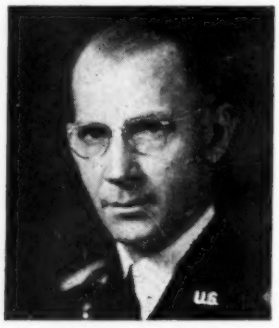
Colonel Davies, chief of the Control Division, Office of the Chief of Ordnance, is secretary—on military leave—of the American Society of Mechanical Engineers.

ORDNANCE ROLL OF HONOR

THE following Ordnance officers and enlisted men have been awarded the Legion of Merit for service as outlined in the accompanying citations:

Col. L. J. Dillon

Col. H. E. Hopping



Col. G. A. Woody

COL. LEO J. DILLON, St. Louis, Mo.—"For outstanding service in the European Theater of Operations, as chief of the Maintenance Division of Ordnance Service."

COL. H. E. HOPPING, Los Angeles, Calif.—"For exceptionally meritorious service as executive and assistant army Ordnance officer at Seventh Army Headquarters."

COL. VICTOR C. HUFFSMITH (then Major), Loveland, Colo.—"For exceptionally meritorious conduct in the performance of outstanding services at Del Monte, Mindanao, Philippine Islands, from December 7, 1941, to April 29, 1942."

COL. GEORGE A. WOODY (Posthumous). Next of kin, Mrs. May P. Woody, widow, Washington, D. C.—"For services from August 1, 1943, to August 25, 1944, as commanding officer of Springfield Armory. During this period, through the application of his technical knowledge of small arms, manufacturing methods, and equipment, improvements in production techniques at the armory resulted in an unprecedented increase in production with a record-breaking reduction in personnel and a consistent decline in costs. All this was accomplished while winning the respect, admiration, and coöperation of all with whom he came in contact." (Colonel Woody died November 30, 1944, at Walter Reed General Hospital, Washington, D. C.)

Col. V. C. Huffsmith

Sgt. W. S. Lacey

Tech. Sgt. F. R. Mace

TECH. SGT. FRANK R. MACE, Saratoga, Wyo.—"For exceptionally meritorious conduct in the performance of outstanding service from July 1943 to December 1943 in the Persian Gulf Command."

S. SGT. CLAIBORNE M. HARDEMAN, Wichita Falls, Tex.—"For exceptionally meritorious service in improvising a large sterilizer for instruments and bandages. This sterilizer was greatly needed at the hospital at the front to take care of the rush of casualties. Sergeant Hardeman exhibited remarkable ingenuity by making this equipment from armor removed from a destroyed German tank. It has cut sterilizing time by six hours."

S. SGT. BENJAMIN C. HORTON, Texas City, Tex.—"For exceptionally meritorious service in improvising a sight instrument illuminator, which could not be detected by the enemy, for crews firing 60-mm. and 81-mm. mortars at night. He showed great skill and ingenuity in developing this piece of equipment."

TECH. 3RD GRADE JAMES BARRON, Sturgis, Miss.—"For exceptionally meritorious conduct in the performance of outstanding service in the Persian Gulf Command from July to December 1943."

SGT. JAMES C. HEMPKINS, Dallas, Tex.—"For exceptionally meritorious service in designing a device with which to extract ruptured shell cases from caliber .50 machine guns. He exhibited

S. Sgt. S. S. Kelso

Lieut. Col. C. E. Sperry

Sgt. M. W. Milloway

great skill and ingenuity in designing this piece of equipment as heretofore gun barrels often had to be sent back to a field Ordnance shop, and hours were lost removing the broken hull. This new device saves much time."

SGT. CLARENCE A. RENFROM, Fort Worth, Tex.—"For exceptionally meritorious service in developing a mandrel for turning out a brake-drum job in twelve hours. His device has saved the Army much valuable time . . ."

TECH. 4TH GRADE WINSTON S. LACEY, Medford, Mass.—"For exceptionally meritorious conduct in the performance of outstanding service from July 1, 1943, to April 1944, in the Persian Gulf Command."

TECH. 4TH GRADE MAX. W. MILLOWAY, Larned, Kans.—"For exceptionally meritorious conduct in the performance of outstanding service from July 1, 1943, to May 1, 1944, in the Persian Gulf Command."

Corp. E. D. Boykin

Sgt. H. W. McGhee

Corp. W. E. Aho

guish the blaze, and prevented it from spreading to other ammunition stores.

SGT. HOWARD W. MCGHEE, Montgomery, West Va.—"On May 11, 1944, at an ammunition dump in Italy, a truck loaded with twenty-four 500-pound bombs burst into flames. Upon seeing the fire, he and three other gallant soldiers rushed to combat the flames with fire extinguishers. Finding it impossible to extinguish the fire, they succeeded in moving the truck to an open field and unloading seven of the bombs before the terrific heat, smoke, and flames forced them to abandon further efforts. . . ."

TECH. 5TH GRADE EARL D. BOYKIN, Burlington, N. J., also received the same citation for participating in the above-mentioned act of heroism.

CORP. WALTER E. AHO, Virginia, Minn.—"For rescuing a fellow soldier who was swept out to sea some 300 yards by a strong undercurrent near Aitape, New Guinea . . ."

TECH. 5TH GRADE DANIEL J. DOBSON, Buffalo, N.Y.—"At Townsville, Queensland, Australia, on March 28, 1944, on his own initiative and unmindful of his own safety, as one of a 2-man crew he drove a 10-ton wrecker over a flooded bridge to rescue fifteen or sixteen men from a truck stalled in the middle of the bridge . . ."

TECH. 5TH GRADE DONALD J. SCHONHART, Buffalo, N. Y., also received the same citation for participation in the above incident.

TECH. 5TH GRADE ROBERT K. EBY, Leola, Pa.—"With an ammunition-dump fire detonating mortar and howitzer shells at Bougainville, Solomon Islands, on March 20, 1944, he hurried to the scene, helped to extinguish the blaze, and prevented it from spreading to other ammunition stores. . . ."

PFC. CHARLES P. GREENE, Northampton, Pa., also received the same citation for participation in the above incident.

THE following Ordnance officer received the Silver Star for service as outlined in the accompanying citation:

LIEUT. COL. CLARENCE E. SPERRY, Tacoma, Wash.—"For gallantry in action in Normandy, France, June 22, 1944. . . ."

Corp. R. K. Eby

Corp. D. J. Schonhart

Corp. D. J. Dobson

THE following enlisted Ordnancemen have been awarded the Soldier's Medal for service as outlined in the accompanying citations:

S. SGT. SAMUEL S. KELSO, Ardmore, Pa.—"On March 20, 1944, at Bougainville, Solomon Islands, he led his men to the scene of an ammunition-dump fire which was detonating mortar and howitzer shells, helped to extin-

THE following officers have been awarded the Bronze Star Medal for service as outlined in each accompanying citation:

COL. GEORGE E. ELLIOT, San Jose, Calif.—"For meritorious service performed with the 7th Infantry Division in connection with military operations against the enemy during the battle of Attu."

CAPT. MERVYN W. LEAVITT, Ogden, Utah.—"For meritorious achievement in connection with military operations against the enemy in the South Pacific area from October 1, 1943, to April 4, 1944."

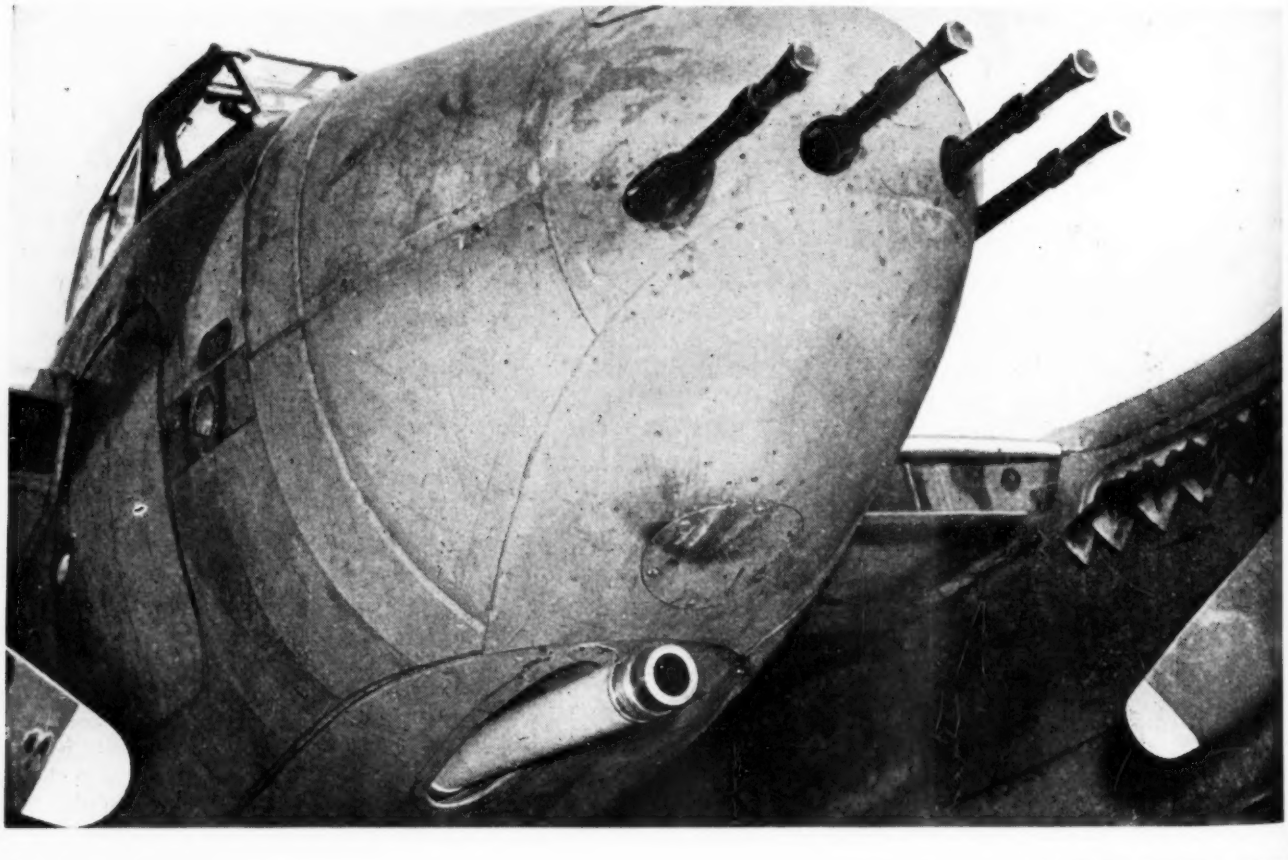
Capt. M. W. Leavitt

Pfc. C. P. Greene

Col. G. E. Elliot

New Firepower for Britain

British antiaircraft tanks are being used in Europe to protect motor convoys from low-flying enemy aircraft. Above is a Crusader tank armed with a 40-mm. antiaircraft gun. The British Mark XVIII Mosquito, below, mounting a 57-mm. 6-pounder gun capable of firing one shot a second, plus four .303 machine guns, is deadly against enemy armor or U-boats (British official photos).



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MARCH-APRIL, 1945

Month by Month

The Shortage of Firepower.—American armies in Germany and the Far East are going to pour the greatest deluge of fire and explosives upon the Axis military forces that has ever been known in history. This determination, according to Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, explains the shortages of vital supplies on the fighting fronts.

"It is not true that the people on the home front—the production front—have failed miserably. Shortages have come from a revision in the over-all planning and thinking, a revision based on actual battle experience. Shortages did not come from the failure of plants to produce what was originally set as the goal of production. Shortages resulted because our combat records indicated clearly that by greatly increasing our expenditure of ammunition, by using our artillery more than in any war to date, we can lay down such a curtain of firepower that our Infantry can advance with fewer casualties.

"The war is speeding up. We have found that by expending more artillery ammunition in a barrage than we formerly thought advisable, our troops can move forward with far greater safety. We can substitute artillery shell and artillery pieces for the lives of American boys. That is the kind of substitution we like to make. It is the American way. Our methods to date are relatively mild compared to what the future holds for Germany and Japan. To accomplish this, we must have an output substantially greater than that which we formerly believed to be ample. We are working feverishly to attain that output so that we can end the war as quickly as possible." These words of the Chief of Ordnance express the attitude of the Industry-Ordnance team. Until the war is won we will continue to turn out guns and ammunition equal to the time of day in Berlin and Tokyo.

Artillery Ammunition Expenditure.—Prime Minister Winston Churchill's reference in his House of Commons' address January 18, 1945, to our losses in the Ardennes made reference to the Battle of Gettysburg. He said that our casualties were "almost equal" to the losses on both sides at Gettysburg. No less an authority than the distinguished Douglas Southall Freeman places the losses of that battle among General Lee's troops at 20,000 and for General Meade's, 23,000. Other authorities have estimated the losses at over 51,000.

What Mr. Churchill did not stress, however, might well be emphasized here; that is, the growing volume of artillery fire of present-day battles in comparison with those of Gettysburg and of other historic encounters. While figures for the principal engagements of this war are not yet available, some idea of the tremendous consumption of artillery ammunition can be gained from the following figures published originally in "America's Munitions, 1917-1918" by Benedict Crowell.

In the 2-day Battle of Chickamauga in 1863, 7,325 rounds of artillery ammunition were expended by the Union Army. In the three days at Gettysburg the same army used 32,781 rounds. As compared with the Battle of the Somme the British, in 7 days in 1916, used 4,000,000 rounds; in the same number of days, at Messines Ridge, 2,753,000 rounds; in 4 days at Saint-Mihiel in 1918 our Army used 1,093,217 rounds.

Equally significant are the rates of artillery fire for each gun daily. The same source gives the following comparisons: In the Crimean War of 1854, the British and French fired approximately 5 rounds daily from each gun. In the Italian War of 1859, the Austrians fired 0.3 rounds; in the American Civil War, the Union Army, 4 rounds. But in World War I, between January 1 and November 11, 1918, the United States Army fired 30 rounds from each gun daily; the French during the same period fired 34 rounds and the British 35.

When the statistics of World War II are made public it will be found that the tonnage of shells fired and the rate of fire for each gun daily will stagger the imagination in the same degree that money expenditures in this war have surpassed those of all others. Mortars designed to fire fifteen rounds a minute in recent battles actually have fired some thirty rounds a minute. The American burden in this conflict in the Ardennes was great, but it has been equally great in every phase on every front in men, munitions, and money. Our people must not forget that—in case any of our present beneficiaries are inclined to forget it in the days to come.

Economy in Ordnance Man Power.—The recent disclosures of the Senate Investigating Committe, under the chairmanship of Senator James M. Mead (Democrat, N. Y.) with reference to wastage of man power in certain Governmental establishments call for prompt, immediate, and fearless correction. With man-power demands such as they are, any waste, loss of time or energy, to say nothing of slacking on

the job in high place or low, cannot be condoned for an instant. It is to be hoped that Senator Mead and his committee members will keep a watchful eye on this nationwide problem, for it is all too apparent that a full day's work by able-bodied individuals is the exception rather than the rule in far too many places!

In this connection, we cite some facts and figures relating to man-power utilization in Industry-Ordnance establishments for the production of arms and ammunition. The American taxpayer's interest is definitely protected. There are fifty-eight such Government-owned company-operated powder and explosives, shell-loading, bag-loading, shell-forging, and chemical plants.

In August 1944, the Army Ordnance Association published a Report by Hon. Albert J. Engel, U. S. Representative from Michigan, ranking member of the War Department Subcommittee of the House Appropriations Committee. That Report, we said at the time, would serve as a frequent basis for sustaining the claim that the Industry-Ordnance team is not only effective but efficient in the production of ordnance for our fighting services. We quote from the Engel Report the following paragraphs which show the remarkable reduction in unit cost and the tremendous saving in man power which has been effected in these Ordnance-controlled industry-operated factories:

"The price of TNT during World War I ran from 26 cents to 55 cents a pound. TNT produced in Government-owned company-operated War Department plants during this emergency dropped from 29 cents a pound to 15 cents to 10 cents, and we are now producing TNT for approximately 7 cents a pound. Smokeless powder was produced during World War I at the Old Hickory Plant at 41 cents to 62 cents a pound. Single-base cannon powder dropped from approximately 21 cents a pound in January 1943 to a little less than 17 cents, while the cost of double-base cannon powder was 26 cents a pound in January 1944.

"A 16-inch shell, complete, including the propelling charge, cost us $1,809 in January 1943. In January 1944, it dropped to $1,430. A 12-inch seacoast shell, complete, including the propelling charge, cost $883 in January 1943. It dropped to $786 in January 1944. It cost 33 cents and took 0.197 man-hours to load a 60-mm. mortar shell in January 1943. The same shell was loaded in February 1944 for 19 cents with 0.110 man-hours. It cost $8.25 and took 2.848 man-hours to load a 240-mm. howitzer shell in April 1943. It cost $5.02 and took 1.51 man-hours to load the same shell in February 1944. It cost $142.80 and took 42.721 man-hours to load a 4,000-pound bomb in June 1943. We loaded the same bomb in February 1944 at a cost of $98.03 and with 27.948 man-hours of work.

"It cost $27.28 and took 9.88 man-hours to load a 1,000-pound bomb in January 1943. The same bomb was loaded in February 1944 at a cost of $16.48, with 4.31 man-hours. It cost $19.36 and took 7.25 man-hours to load a 500-pound bomb in January 1943. The same bomb was loaded in February 1944 at a cost of $9.28 and with 3.15 man-hours. It cost $3.05 and took 1.21 man-hours to load a 155-mm. shell in January 1943. It cost $1.81 and took 0.567 man-hours of work to load the same shell in February 1944. While there were some slight increases in the cost of labor to load some units, the usual reason for this increased cost was changing methods of packing, type of container, and similar causes."

Notwithstanding this enviable record, the Industry-Ordnance team will strive constantly for further savings both for the proper utilization of men and that all-but-forgotten precept, thrift in the handling of other people's money.

Universal Military Training.—ARMY ORDNANCE takes its stand squarely beside the War and Navy Departments in advising the adoption of a system of universal military training. It does so because such a system conforms with our true military policy enunciated by that renowned soldier, our first President, George Washington. It rests upon the fundamentally democratic principle that in a free state every able-bodied citizen *should* train to defend his country. Today the nature and scope of warfare have expanded to such a degree as to *require* that every physically fit male of proper age be trained to serve in the armed forces. The only efficient, constitutional, and democratic way of meeting this requirement is through a system of universal military training. Similar results cannot be obtained by any volunteer system. Experience in our last two major wars has proved this conclusively.

To the objections now loudly raised against compulsory military training legislation, the answers are quick and conclusive. If such a system is not adopted now there will be large numbers of men of military age subject to call in time of emergency who will not have had the opportunity of receiving this training, and hence will not be ready for immediate military service. The disposal of surplus supplies, matériel, training facilities, air and ordnance installations cannot be planned wisely and expedited until a decision on this subject is reached. Delay will result in additional costs for reëstablishing facilities. The training would be conducted in Army training camps and schools in the United States for twelve months. The program proposed by the War Department requires an uninterrupted year of military training.

As to the effect of such training upon education, the War Department advocates the completion of the year of universal training between graduation from high school and entrance into college. There will be no adverse effect on primary and secondary school education. For those desiring to enter college, there would be a delay of one year. No part of the Army program is intended to replace any civilian educational program. The training, however, will be a military stimulus and a supplement to the education received under civilian control. A large part of it will be vocational. However, the educational advantages of the system are not its primary purpose which is the provision for national security.

In the words of Maj. Gen. Walter L. Weible, spokesman for the War Department on this subject: "Today practically all our citizens know of the realities of war and the horrors connected with it. This is the time to use this knowledge to determine what proper measures should be taken to protect their hard-won security. Tomorrow these realities will be forgotten and inadequate measures will again result."

Elsewhere in this issue is published a splendid statement of the case by the national commander of the American Legion, Edward N. Scheiberling. With his thesis there should be general agreement. As a Nation we will have been too stupid to merit freedom and security if we have not learned the great military-industrial lesson of this war: *constant and immediate strength in trained man power and superior firepower to assure peace for ourselves and our posterity.*

Our Tanks Are Without Equal

An Editorial

GENERAL EISENHOWER, Supreme Allied Commander, and General Patton, commanding the Third United States Army in the European Theater of Operations, have put their respective approvals on our American ordnance in no uncertain terms—approvals which should go a long way toward reassuring the American people in their hour of trial. Both battle commanders and others have expressed themselves in letters to Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, who recently returned from a 4-week inspection tour of the French and Italian battle fronts.

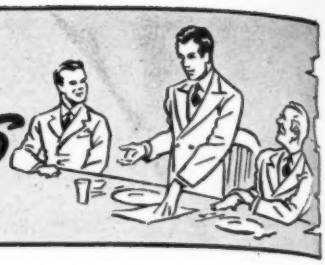
¶ Said General Eisenhower: "Battlefield reports from every front in the European Theater of Operations continue to tell of the splendid quality of our weapons and ammunition. What we need is more of both, as well as men, to finish the job. Last summer the enemy was defeated in Normandy by our firepower and the teamwork of our splendid soldiers at their rifles, mortars, machine guns, artillery; in their tanks and tank destroyers. The enemy then retreated 500 miles, leaving behind much equipment in order to reach temporary security in his fixed defenses. The mobility of our ordnance enabled us to exploit our first successes in the drive across France, into Belgium and Germany. Moreover, throughout the war there has been a noticeable and steady improvement in the quality of many of our weapons and equipment. Such improvement is mandatory always; the alternative is stagnation and eventual disaster.

"The effectiveness of our ordnance is partly due to simplicity in design and partly to the range of United States equipment which provides a weapon for every target. The enemy's battle losses have been far greater than ours. In pieces of artillery, the enemy has lost eight to our one. We have knocked out twice as many tanks as we have lost. We have a general superiority in quality and quantity of our ordnance, a superiority that must always be maintained."

¶ Said General Patton: "In my opinion, the M1 rifle is the greatest battle implement ever devised. However, my admiration for Ordnance products does not stop with the M1 rifle. Our machine guns, mortars, artillery, and tanks are without equal on the battlefields of the world. In the hands of the unconquerable veterans now composing our armies, the utter destruction of the armed forces of our enemies is certain."

¶ The Industry-Ordnance team has only one reason for its existence—to give the American fighting man the best of weapons—but at all odds to give him the weapon he wants. If there are tacticians here or abroad who believe otherwise, the pages of ARMY ORDNANCE are open for a full and constructive statement of the case. Meanwhile, Americans at home and overseas can be assured that the Industry-Ordnance team will continue to give GI Joe what he wants—without stint or limit in quantity and quality.

Association Affairs



MID-CONTINENT POST

Some months ago, initial steps were taken toward the inauguration of a local Post of the Army Ordnance Association with headquarters at Tulsa, Okla. As a measure of continuing interest, nearly one hundred citizens of Tulsa and its environs became life members of the Association and charter members of the new Post. Never before in the history of the Association have so many life members enrolled at one time in one locality. This historic happening was due in large measure to the energy and enthusiasm of Capt. Thomas E. McVay, Ord. Dept., and W. G. Skelly, president, Skelly Oil Company, Tulsa. Col. Clyde G. Morgan and Col. Richard W. Coward, chief and assistant chief, respectively, of the St. Louis Ordnance District, gave the new chapter their joint fatherly blessing.

The inaugural meeting was held at Camp Gruber, Okla., December 12, 1944, when Frank Hinderliter, president of the Hinderliter Tool Company, Tulsa, and one of the Midwest's manufacturers of high-quality artillery gun barrels, was elected president. Nearly 300 members attended the inaugural meeting for the presentation of the charter and a demonstration of latest Army weapons.

Present at the speakers' table at luncheon, where George Nicholson presided, were Col. Landon J. Lockett, commanding officer at Camp Gruber; Mr. Skelly; Col. J. L. Massey, commanding officer, 64th Ordnance Company; Lieut. Col. Donald Y. Shaffer, commanding officer, 140th Evacuation Hospital; R. R. King, president, American Body & Trailer Company; B. F. Barnett, vice-president, First National Bank and Trust Company, Tulsa; Col. B. Beall, chief of staff, 42nd Infantry Division; Mr. Hinderliter; Colonel Coward; and Col. Russell Riggins, recently on active duty in the Office of the Chief of Ordnance.

The flag of the Army Ordnance Association and the charter were presented to the new president by Lieut. Col. Weston A. Price, chief Ordnance officer and director of supply at Camp Gruber.

Colonel Morgan introduced Maj. Gen. Harry J. Collins, commanding general, 42nd Infantry Division, Camp Gruber. General Collins delivered a stirring address to the members of the new Post and their guests which will long be remembered as a clarion call for industrial preparedness. General Collins spoke in place of Brig. Gen. H. R. Kutz, chief of the Training Service, Ordnance Department, who was prevented from attending as scheduled by adverse flying conditions.

The exhibit of weapons incident to the inauguration of the new chapter was one of the most interesting and instructive ever presented to a group of members of the Association. Each military unit at the camp conducted a special presentation which reflected great credit not only on the commanding officers and personnel of the respective units but also on the weapons which were used. The bazooka and the 81-mm. mortar came in for exceptional praise.

The officers of the Mid-Continent Post, in addition to Mr. Hinderliter, are: R. R. King of the American Body & Trailer Company, Oklahoma City, 1st vice-president; George Nicholson of the Macnick Company, Tulsa, 2nd vice-president; Captain McVay, secretary-treasurer. Directors elected include the officers and H. E. McCray, chief engineer, Cabot Shops, Inc., Pampa, Tex.; W. H. Stueve, chief power consultant, Oklahoma Gas & Electric Company, Oklahoma City; W. W. Siegrist, vice-president and manager of the Springfield Trailer Company, Springfield, Mo.; Walter O'Bannon, Jr., vice-president and works manager, Walter O'Bannon Company, Tulsa; Ed Warmack, president of the Warmack Stove Company, Fort Smith, Ark.; and M. H. Johnson, Midwest Engineering & Tool Company, Neodesha, Kans.

MICHIGAN POST

Under the chairmanship of Prentiss M. Brown, president of Detroit-Edison Company, former Senator from Michigan and past director, Office of Price Administration, a campaign for the enrollment of members of the Association throughout the State of Michigan is under way. The first meeting of Mr. Brown's special membership committee was held at a luncheon in the Rackham Memorial Building, Detroit, December 14, 1944. K. T. Keller, president, Chrysler Corporation, and a director of the Army Ordnance Association, presided. The principal speaker was Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance.

Other speakers were E. T. Gushée, president of the Michigan Post; Col. James L. Walsh, a director, and Col. L. A. Codd, executive vice-president of the Association. Among the other honor guests were Brig. Gen. A. B. Quinton, Jr., chief, Detroit Ordnance District; Col. H. W. Alden, former president of the Michigan Post and a director of the Association; C. E. Wilson, president, General Motors Corporation; Oscar Webber and B. E. Hutchinson, directors of the Michigan Post. The present campaign, ably directed by Ed Gushée, capably assisted by Clifford A. Mogk, Detroit Ordnance District, and James W. Lee II, of the Chrysler Corporation, is best described in the words of Mr. Keller in his opening remarks at the meeting:

"This is not the first time that many of us who are here today have come together to give the 'kickoff' to a campaign to enlist the interest of our fellow citizens. From time to time we have accepted responsibility for Michigan's part in many causes of national civic importance. I do not know any of them that is more important to the national welfare, in a very fundamental sense, than the campaign we are starting here today to recruit members for the Army Ordnance Association. Nor do I know any that should appeal so strongly to the common sense of the men who operate American business and industry.

"There are distinguished men present here who, over many of the last twenty-five years, in a quiet but effective way have given a demonstration of practical patriotism that is all too little appreciated by the American people. Even in this war period, when the people have seen, if they did not realize, the results of this work, the meaning of it and the necessity for its continuance have not been recognized.

"My own belief is that to a very large extent the success of our armed forces in all theaters of war, in so far as weapons are concerned, should be attributed to the idea that is represented by this Association. That idea is Industry-Ordnance teamwork in the development and production of national preparedness."

CLEVELAND POST

Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, was the honor guest and principal speaker at a meeting of the Cleveland Post, Army Ordnance Association, at the Carter Hotel, December 19, 1944. The meeting was held in conjunction with the Chamber of Commerce and was presided over by Clifford F. Hood, president of the American Steel & Wire Company and president of the Cleveland Post.

More than a thousand members and guests were in attendance

to hear General Campbell, who was introduced by Col. E. A. Lynn, chief of the Cleveland Ordnance District. Also in attendance at the meeting were the chiefs of the thirteen Ordnance districts who that day were gathering in Cleveland for their quarterly progress conference. Brig. Gen. Benedict Crowell, president of the Association, and all officers and directors of the Cleveland Post, were also among the honor guests.

Under Mr. Hood's direction, the Cleveland Post has now embarked upon an important campaign which has as its objective a complete enrollment of Ordnancemen in the many industrial areas in the Cleveland Post territory. The area chairmen are: Albert J. Weatherhead, Jr., the Weatherhead Company, Cleveland; G. W. Stephens, Mansfield Tire & Rubber Company, Mansfield, Ohio; Ward M. Canaday, Willys-Overland Motors, Inc., Toledo; Clyde Williams, Battelle Memorial Institute, Columbus; James E. Trainer, Firestone Tire & Rubber Company, Akron; Dan S. Ellis, Lima Locomotive Works, Lima, Ohio; William Forster, Jr., Hays Manufacturing Company, Erie, Pa.; Henry A. Roemer, Sharon Steel Corporation, Sharon, Pa.; W. R. Timken, Timken Roller Bearing Company, Canton, Ohio.

Under the guidance of Mr. Canaday, the "kickoff" meeting in the Toledo area was held at the Commodore Perry Hotel, Thursday, January 11, 1945. At this meeting the principal address was given by Maj. Gen. C. T. Harris, Jr., commanding the Aberdeen Proving Ground, Md. Many of the industrial and labor leaders of the Toledo section were in attendance.

At the election of officers for the Cleveland Post, announced January 6, Colonel Lynn and Mr. Weatherhead were elected directors. Others announced at the meeting held in the Union Club were Mr. Stephens and Mr. Timken. Mr. Hood was reëlected president; John C. McHannan, chairman of the board of the Central National Bank of Cleveland, was reëlected first vice-president; and Mr. Canaday, second vice-president. The membership campaign as well as the general activities of the Cleveland Post are under the capable and tireless direction of William I. Ong, director of public relations, American Steel & Wire Company; and Maj. Clarence G. Wood of the Cleveland Ordnance District.

PICATINNY ARSENAL

At a meeting sponsored by the Army Ordnance Association at Picatinny Arsenal on January 31st, a round-table discussion on "Land Mines and Booby Traps" was presented by members of the Ordnance School, Aberdeen Proving Ground, and awards for outstanding service were presented to civilian employees of Picatinny.

Col. W. R. Slaughter, commandant of the Ordnance School, presided at the round table and gave the opening address. Capt. J. V. Agnes, chief, Ammunition Branch, Ordnance School, also spoke, and the panel discussion was conducted by Maj. R. J. Russo and Lieuts. L. C. Smith, Jr., J. E. Cobb, Jr., and T. B. Hanchett. Col. L. A. Codd, executive vice-president of the Association, also spoke.

Col. Miles W. Kresge, of Picatinny Arsenal, presided at the presentation of awards, and the principal addresses were given by Col. W. E. Larned, commanding officer of Picatinny, and Brig. Gen. R. E. Hardy, chief, Ordnance Department's Ammunition Division. The recipients of the Exceptional Civilian Service Award were: Donald R. Cameron, Robert L. Clothier, Harry Hance, Frederick W. Hanschka, Wilfred Hosking, John M. King, William L. Lukens, Clarence A. Murphy, William H. Rinkenbach, Alfred F. Teitscheid.

The following received the Meritorious Civilian Service Award: Angelo E. Benedetti, Frederick E. Byrne, Raleigh T. Curtis, Harold S. Eroe, Frederick M. Griggs, Edgar B. Holley, John C. Hunt, Jr., Thomas E. James, Charles W. Jump, John C. Kolcinsky, Peter A. Moglia, Alexander H. Molnar, Aurel A. Mossey, William J. Norris, Francis G. Olmstead, Warren Partridge, Jr., Virgil R. Reed, George F. Stafford, Guy A. Stoner, Francis M. Willett.

BILL HOLLER'S MEMBERSHIP DRIVE

The most phenomenal single addition to the membership growth of the Army Ordnance Association during the past twenty-six years is attributable to William E. Holler, general sales manager, Chevrolet Motor Division, General Motors Corporation. Due to his ability and enthusiasm, 7,519 new members of the Army Ordnance Association have been enrolled! He organized and directed a membership campaign among Chevrolet dealers throughout the country, enrolling not only the dealers themselves but also some of their principal fellow citizens in other fields—business, law, the ministry, statecraft, medicine—in each dealer's locality. Nothing quite like it has been done heretofore to spread a knowledge of Ordnance among such influential citizens throughout the Nation. In slight tribute to Mr. Holler's outstanding service he has been presented the Army Ordnance Gold Membership Emblem as a token of appreciation (see page 268).

William E. Holler
He enrolled 7,519 new members.

Mr. Holler's peacetime responsibility is to direct a vast organization that normally sells $1,500,000,000 worth of merchandise a year. In the eleven years of his administration he has been head of a sales organization employing more than 30,000 men. It is said that his administration marks the longest tenure of any sales manager in the four decades of automotive history. He is credited with selling more than fifty per cent of all cars and trucks produced by Chevrolet since it first began business in 1912, increasing the Chevrolet owner population eighty-one per cent over its 1933 figure.

Bill Holler's career in the automotive business began at Flint, Mich., in 1920. A man of keen foresight and tremendous physical energy, he is an organizer of outstanding ability.

Little wonder that a man of such talent and forcefulness should see the place of Ordnance in the winning of the war and in the days of peace. The Army Ordnance Association is much the gainer by his interest in its work, and the American people can take pride in what he has done for spreading the Ordnance doctrine throughout the land. One method he used to great advantage in the Chevrolet membership campaign was the preparation in booklet form of a chart talk, "We Want Peacetime Patriots Too." This booklet is now being revised for general use, and copies of it will be available shortly for members and their interested friends who may be prospective members.

To Bill Holler's two associates, Tommy Brents, now zone manager for Chevrolet at Atlanta, Ga., and A. G. Letherby, assistant manager of the merchandising and training department of Chevrolet at Detroit, goes much of the credit for the success

with which this milestone on the road of Ordnance progress was erected. The Association gratefully acknowledges its indebtedness to these patriotic gentlemen.

SMALL-ARMS AND AMMUNITION INDUSTRY

The small-arms and ammunition industry in the United States commemorated its fifth anniversary of war service at a meeting at the Waldorf-Astoria Hotel, New York City, on January 4, 1945, with more than 1,300 representatives of the industry in attendance. Thomas J. Watson, president, International Business Machines Corporation, presided at the meeting, and Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance, was the honor guest.

Participants in the program of addresses included representatives of the "old-line" small-arms and small-arms ammunition producers and also spokesmen for those companies not normally engaged in small-arms manufacture but which have established such enviable records in these fields during the present war. Also participating in the program were representatives of the Navy, the Marine Corps, the Infantry, the Air Forces, and the Ordnance Department.

The complete roster of speakers follows: Invocation, Chaplain George D. Lessley, Captain, A.U.S.; addresses (in addition to General Campbell), Mr. Watson; C. L. Horn, president, Federal Cartridge Company; Graham Anthony, president, Colt's Patent Fire Arms Manufacturing Company; Maj. Gen. Fred L. Walker, commandant, the Infantry School, Fort Benning, Ga.; Brig. Gen. Richard C. Coupland, Ordnance officer, Army Air Forces; Rear Adm. George F. Hussey, Jr., U.S.N., Chief of the Navy Bureau of Ordnance; Brig. Gen. Gerald C. Thomas, U.S.M.C., director of plans and policy, U. S. Marine Corps; Rev. Robert I. Gannon, S.J., president, Fordham University; Brig. Gen. James Kirk, chief, Small Arms Division, Office of the Chief of Ordnance; benediction, Chaplain Roger J. Connair, Lieutenant, U.S.N.R.

The papers presented at this meeting were of such historic value that the entire proceedings will be published by the Army Ordnance Association as an Army Ordnance Report. Copies will be furnished all members in due course. This document contains data on the production achievement of the Industry-Ordnance team in meeting the mammoth small-arms requirements originally scheduled for our own and Lend-Lease requirements.

MEMBERSHIP EMBLEMS AWARDED

Brig. Gen. Benedict Crowell, president of the Army Ordnance Association, has conferred the Association's Gold Membership Emblem upon the following members in special appreciation of their efforts and help toward increasing the membership:

William E. Holler, general sales manager, Chevrolet Motor Company, Detroit, Mich., for his phenomenal achievement in directing the enrollment of 7,519 new members, most of them on the 3-year basis, many of them Chevrolet motor dealers throughout the country and their friends in all walks of life. The presentation was made by Brig. Gen. A. B. Quinton, Jr., chief, Detroit Ordnance District.

C. Jared Ingersoll, chief of the Philadelphia Ordnance District, for enrolling as members of the Ordnance fraternity the largest Ordnance district enrollment in the history of the Association. The Philadelphia District area includes the huge membership of the Aberdeen Proving Ground Post and the equally large enrollment of the Washington Post. The presentation to Mr. Ingersoll was made by Col. J. B. Rose, commanding officer, Frankford Arsenal.

Brig. Gen. H. R. Kutz, chief of Ordnance Training Service, for his assistance in enrolling so many new members of the automotive industry. "Jack" Kutz, a charter member of the Association, has been one of its guiding stars and towers of strength through all the years. His coöperation with Mr. Holler and Colonel Reno (see below) was a major part of the success which was attained in enrolling so many representatives of the automotive industry and their friends. The presentation to General Kutz was made by Col. L. A. Codd, executive vice-president of the Association.

Capt. Thomas E. McVay, secretary-treasurer of the Mid-Continent Post, Army Ordnance Association, Tulsa, Okla., for organizing the new Mid-Continent Post. As an assurance of continuing interest on the part of charter members of the new local chapter, eighty-seven new life members were enrolled in addition to seventy-eight annual members. Captain McVay's industry, pleasing personality, and unfaltering loyalty to Ordnance inspired all his associates in the Mid-Continent area to this historic beginning of a new local chapter. The medal was presented to Captain McVay by Col. Richard W. Coward, assistant chief, St. Louis Ordnance District.

Louis Polk, Sheffield Corporation, Dayton, Ohio, who, as chairman of the membership committee of the Cincinnati Post, helped to increase the membership of that chapter during 1944 to 3,606. In coöperation with Colonel Shouvlin, and with the aid of an outstanding committee of members, he brought to the membership campaign the same fine planning and results which characterized his participation in the raising of the Ordnance Endowment Fund two years ago. The emblem was presented to Mr. Polk by Frederick V. Geier, president of the Cincinnati Post, on behalf of the Association.

Lieut. Col. William M. Reno, General Motors Corporation, Denver, Colo., for his leadership in interesting the automobile dealers of the country in the work of the Army Ordnance Association. Bill Reno worked in close collaboration with Mr. Holler and also with the heads of the dealer organizations of other automobile producers and with the officials of the National Automobile Dealers Association. In all, more than 10,000 new members have been added to the roster through Colonel Reno's energetic and persuasive conviction that Ordnance preparedness is a sure guaranty of peace. The presentation was made in General Crowell's name by James D. Maitland, president, Rocky Mountain Post.

Col. Joseph C. Shouvlin, chief, Cincinnati Ordnance District, for putting the Cincinnati Post at the top of the list of all twenty-six posts of the Association. Its membership December 1, 1944, was 3,606. Joe Shouvlin inspired the members of the Industry-Ordnance team throughout the Cincinnati Post area so that what has always been one of the strongest Ordnance-minded regions in the country is now the leader of them all. Acting for General Crowell, Mr. Geier presented the medal to Colonel Shouvlin.

W. G. Skelly, president, Skelly Oil Company, Tulsa, Okla., a leader in civic and industrial affairs of Tulsa, for his helpful and continuous interest in establishing the Mid-Continent Post. The Skelly-McVay team jointly brought the Ordnance message to the good people of Tulsa and convinced nearly one hundred of them that it warrants their lifetime interest and coöperation. The presentation to Mr. Skelly was made in General Crowell's name by Colonel Coward.

Col. Dean Witter, deputy chief, San Francisco Ordnance District, for his outstanding service in reorganizing the San Francisco Post. He interested an outstanding group of leaders in the affairs of the Post and has succeeded in bringing its enrollment to an all-time high. The presentation to Colonel Witter was made by Col. K. B. Harmon, chief of the San Francisco Ordnance District.

NECROLOGY

Brig. Gen. LeRoy Hodges, outstanding authority on ordnance, public finance, and economics; director of the Washington Post, Army Ordnance Association; and formerly a national director of the society, died at Richmond, Va., December 18, 1944. Long identified with the National Guard of Virginia, he served as Ordnance officer of that organization for many years on the staff of the Adjutant General, Brig. Gen. S. Gardner Waller.

Early in the preparation for the present war, General Hodges

was called to active duty with the rank of lieutenant colonel, first on the staff of Maj. Gen. R. L. Maxwell, Administrator of Export Control, and later in the office of Maj. Gen. C. M. Wesson, Chief of Ordnance. In June 1942, he was returned to inactive status by reason of a severe illness which ultimately caused his death.

Than LeRoy Hodges, there was no finer, more popular, more competent, or more sincere gentleman ever to wear the uniform of the Army of the United States. Two weeks before his death, Governor Darden of Virginia elevated him to the rank of brigadier general in the Virginia Militia. Born at Tarboro, N. C., July 12, 1888, General Hodges was graduated from Washington and Lee University. An economist of recognized standing, his great contribution to the Commonwealth of Virginia was as managing director of the State Chamber of Commerce and later as Comptroller of the State. Author of "Postwar Ordnance" (1923), and contributor for many years of "Ordnance Notes" to the *Virginia Guardsman* (1931-1939), General Hodges was an aggressive and sustaining influence for better and simplified ordnance equipment. Frequently, in the pages of this journal, he wrote on the need for industrial preparedness and served on many of the Association's committees toward that end through the years.

All his comrades in the Army Ordnance Association can share the sentiment expressed in the following editorial, published at the time of General Hodges' death, in the *Richmond News Leader*, edited by the distinguished Douglas Southall Freeman, chairman of the Ordnance Historic Advisory Committee, which we take the liberty of quoting in full:

> "The name of LeRoy Hodges first appeared in the city directory of Richmond as that of private secretary of Governor Westmoreland Davis. Often thereafter his title changed —budget assistant, budget director, executive director of the State Chamber of Commerce, bureau chief of the Federal Social Security Board, Comptroller of Virginia, Lieutenant Colonel of the Ordnance Department, U.S.A. These changes were not the result of restlessness but of successive new and challenging opportunities. Endowed as he was with character, fine personality, high ability, unusual equipment, great energy, flawless courage, and excellent judgment, he was the man to discharge endless new tasks in a swiftly changing Old Dominion.
>
> "In addition to professional appointments, he had two special avocations—prison administration and the development of ordnance. Both these in a sense were accidental: He went on the Prison Board because Governor Davis needed some capable man to reorganize that body; Colonel Hodges took up ordnance because he felt he should share in the national defense. The strength of his mind and the vigor of his inquiry contributed to this notable record: to every field of his activity he made permanent contribution. A discriminating list of notable men in any sphere of his versatile range will include his name, a name among the highest and most devoted of his generation of Southerners.
>
> "LeRoy Hodges' political testament to Virginia was his program of fifteen 'points' published January 29, 1941, when he was being mentioned as a possible candidate for governor. That fine program emphasizes the shining fact we record in the preceding paragraph—that Colonel Hodges' footprints will be found even now on every road he covered before his long illness. It was the same in the comptroller's office. So thoroughly and so boldly did he clean up the tax delinquency of certain politicians that only the most venal and defiant of future financial officers ever again will dare permit tax bills to remain unpaid by politicians who thought themselves above the law."

With this well-deserved estimate all will agree, especially those of us who had the good fortune to know General Hodges intimately, whose interests and concerns were like unto his, and none more sincerely than the writer of these lines who was privileged to call him friend. L. A. C.

Col. George A. Woody, a distinguished Ordnance officer and formerly in command of the Springfield Armory, Springfield, Mass., died November 30, 1944, at Walter Reed General Hospital, Washington, D. C., after an illness of several months. He had recently received the Legion of Merit for exceptionally meritorious service in the outstanding performance of his duties at Springfield Armory where the semiautomatic M1 rifle is manufactured. Colonel Woody's citation and photograph appear on page 260 of this issue.

Colonel Woody attended Texas Agricultural and Mechanical College and was commissioned a second lieutenant in the Coast Artillery in October 1917. He transferred to the Ordnance Department in 1921 and filled many posts of great responsibility in the Department during the past twenty-three years.

Rev. Francis W. Power, professor of chemistry at Fordham University for the past twenty years, died at the university December 16, 1944. He was especially noted for his researches in the chemistry of smokeless powder and took an active interest in ordnance affairs, especially those connected with the development of powder and explosives.

A native of Worcester, Mass., Father Power was graduated from Holy Cross College and Clark University. During World War I he was assistant chief chemist at the Du Pont Laboratory, Carney's Point, N. J. After years of preparation, he joined the faculty at Fordham University in 1924 as professor of quantitative analysis. Since 1933 he was professor of organic microanalysis. A contributor to the pages of this journal, one of his best-known papers was "A Calculated Relation between the Ballistics of the 75-mm. Gun and the Mean Web of the Powder," published in the July-August 1925 issue (Vol. VI, No. 31, p. 21). In Father Power's death, American education, the Church, and Ordnance have lost a distinguished leader who contributed much to their advancement.

Kendall Banning, editor, author, and member of the historical section of the Ordnance Department, died at Baltimore, Md., December 27, 1944. He directed the compilation of a pictorial record and history of World War I and, until his final illness, was engaged in writing the history of the Ordnance training activities in this war. He is best known for his popular books "West Point Today," "Annapolis Today," and "The Fleet Today." He attained the rank of major during World War I and subsequently served as a Reserve officer with the rank of lieutenant colonel.

Born in New York City, September 20, 1879, Colonel Banning was graduated from Dartmouth College in 1902. Subsequently he served as managing editor of *System, Cosmopolitan,* and *Hearst's Magazine.* Later he was editor of *Popular Radio* and editorial director of *Public Utilities Fortnightly.* The Ordnance historical project upon which he was engaged at the time of his last illness is one of the most important undertakings of the entire Ordnance Department of the Army. The narrative of its training achievements from the pen of Ken Banning would have been reading on a par with his Annapolis and West Point volumes which for years have been most popular with American youth.

NOTICE also has been received of the deaths of the following members of the Association: A. C. Armstrong, Holyoke, Mass.; William M. Bager, South Milwaukee, Wis.; Earl Casler, Los Angeles, Calif.; Vernon B. Chase, Cincinnati, Ohio; James C. Dorman, Detroit, Mich.; Henry K. Dunham, Cincinnati, Ohio; Martin F. Geipe, Madison, Ill.; William H. Hazard, Chicago, Ill.; C. W. Heppenstall, Pittsburgh, Pa.; Albert W. Howe, Poughkeepsie, N. Y.; Fred E. Johnston, Evanston, Ill.; Gordon F. Keyes, Salem, Ohio; Robert M. Pennell, Jr., Portland, Me.; R. E. Power, Birdsboro, Pa.; A. P. Robinson, Dunellen, N. J.; Stanley W. Sparks, Norwalk, Conn.; James F. Sutton, Philadelphia, Pa.; Clarence S. Swanson, Chicago, Ill.; Charles L. Taylor, Hartford, Conn.; J. H. Van Alstyne, New York, N. Y.; Edward R. Will, Philadelphia, Pa. To their relatives and friends, ARMY ORDNANCE, on behalf of the Association membership, extends condolences.

ORDNANCE IN REVIEW

German Submachine Gun MP43

Melvin M. Johnson, Jr.

A MOST significant development in shoulder-fired automatics is the latest German model submachine gun or "carbine," officially designated "MP43," in caliber 7.9-mm. *short*. This gun is selectively full and semiautomatic, cocked with a closed bolt, and actuated by a gas system similar to the Czech Z.B. and British Bren. The 30-shot box magazine, like on the U. S. submachine gun M3, is inserted underneath. The over-all length is about 36 inches with 16-inch barrel, and the weight is about 10.5 pounds. The stock is of the straight-in-line type with sights high above the bore.

The over-all length of the standard 7.9-mm. cartridge is 3.1 inches. The new 7.9-mm. *short* is 1.93 inches. The standard 7.9-mm. with 154-grain flat-base bullet, gives a muzzle velocity of about 2,540 foot-seconds and a muzzle energy of 2,200 foot-pounds. The 7.9-mm., 125-grain short gives about 2,000 foot-seconds and a muzzle energy of about 1,110 foot-pounds. The accompanying comparative table indicates the relative efficiency of several pertinent cartridges in terms of their size, velocity, and energy (figures are approximate).

Caliber	*Bullet Weight*	*Muzzle Velocity*	*Muzzle Energy*	*Approx. Over-all Length*	*Cartridge Base Diameter*
U.S. .30 M2	150 grains	2,800 foot-seconds	2,615 foot-pounds	3 11/32 in.	31/64-in.
U.S. .30 A.P.	162 "	2,770 "	2,759 "	3 11/32 "	31/64 "
7.92-mm. Mauser	154 "	2,540 "	2,200 "	3 5/32 "	31/64 "
.300 Savage	150 "	2,550 "	2,165 "	2 17/32 "	31/64 "
.276 Experimental	125 "	2,700 "	2,050 "	2 26/32 "	27/64 "
7.92-mm. MP43	125 "	2,000 "	1,110 "	1 29/32 "	31/64 "
.30 Carbine	110 "	1,900 "	880 "	1 21/32 "	23/64 "
9-mm	125 "	1,100 "	336 "	1 5/32 "	26/64 "
.45 A.C.P.	230 "	825 "	346 "	1 9/32 "	31/64 "

Comparative characteristics of various types of cartridges.

The table indicates that the 7.9-mm. short is highly efficient for its size. It has more than half the muzzle energy of the 7.9-mm. Mauser cartridge and roughly three-fourths the muzzle energy of the .276 and .300 Savage, although roughly one inch shorter. Being only a fifth of an inch longer it has nearly twice the muzzle energy of the .30 carbine cartridge. It is nearly 1½ inches shorter than our .30 M2 rifle cartridge.

THIS new cartridge and the gun which fires it raise a number of questions. As with all ordnance problems, both the technical and tactical aspects must be evaluated and envisioned. With small-arms ordnance, one must think like an infantryman, act like an engineer, and sound like a soothsayer. Consider the following:

1. The MP43 gun replaces or otherwise fills the rôle of "carbine," semiautomatic rifle, submachine gun, and automatic rifle.

2. The cartridge is truly a medium-power rifle load, effective up to 400-500 yards. It permits accurate semiautomatic fire at medium rifle ranges.

3. The MP43 does not replace the pistol, as does our M1 carbine. It weighs twice as much as our carbine and holds twice as many (30) rounds.

4. The MP43 is a logical companion arm for the belt-fed, 26-pound light machine gun (MG34, MG42, MG43) of the German Army. Germany now is fighting a defensive war. Machine-gun teams of three men armed with one MG42 and two MP43 guns may prove quite effective in terms of fire effect, firing from emplacements.

5. The MP43 seems a better-designed German weapon than the somewhat clumsy Gewehr 41 semiautomatic rifle and the somewhat flimsy parachute automatic, FG42. Structurally the magazine of the MP43 is better made than the body of the gun. The smaller cartridge also means a saving in vital ammunition materials, more shots per pound of powder, lead, and steel. (German cases are steel instead of brass.)

6. A short cartridge having relatively good pressures is very favorable for automatic-gun design as the breechblock need not travel so far during the action stroke. The generous total weight of the MP43 gives the designer much greater freedom with important parts such as breechblock, operating shaft, piston, receiver, and magazine. As much power can be used in the gas action as in a full-size 7.9-mm. gun; but with 1¼ inches less stroke, the momentum of the moving parts is not so dissipated. This permits a relatively stronger mainspring and relatively more overtravel back of the cartridge next to be fed.

OUR own carbine M1 may have influenced this German (possibly Czech) design. However, our Ordnance Department sought to replace the pistol with the 5-pound M1 carbine, a "two-hands-for-beginners" weapon light enough not to burden officers and noncoms unduly. Our troops already had the semiautomatic rifle, the automatic rifle, the M1 and M3 submachine guns, and the tripod-mounted M1919A4 machine gun, all in the rifle company. To that array the carbine was a logical addition.

Modern infantrymen are engaging targets at distances and under conditions which necessitate real *rifle* power, range, penetration, and accuracy. Our standard .30 M1906 cartridge can be loaded to give 2,800-3,000 foot-pounds' muzzle energy, or practically double that of the 7.9-mm. short. Our .30 armor-piercing load has nearly 900 foot-pounds' energy at 700 yards and a terminal velocity at that range of 1,500 feet per second, whereas the 7.9-mm. short falls below these figures at 300-350 yards. Then there is the highly important factor of wind drift. The light bullet is blown off much more than the heavy one.

The new German gun weighs 10.5 pounds with roughly 1,500 foot-pounds' muzzle energy per shot, but it has been proved practicable to build, in caliber .30 M1906, a full- and semiautomatic shoulder weapon weighing only 12.5 pounds, with nearly double the muzzle energy per shot.

Mr. Johnson is a leading authority on all types of firearms, having invented several pieces. He holds a commission as captain in the U. S. Marine Corps Reserve.

New weapons indicate trends. The MP43 evidences another step toward a full- and semiautomatic shoulder weapon of rifle caliber weighing only a few pounds more than a conventional rifle. It shows a further attempt to integrate the features of a submachine gun, carbine, semiautomatic rifle, and automatic or machine rifle into one complete gun.

The Caliber .50 Machine Gun—Its Conception

Dr. Henry B. Allen

OUR caliber .50 Browning machine gun is one of the outstanding weapons of this war, which fact our enemies well know by this time. It may be of interest to the readers of ARMY ORDNANCE to learn something of the background behind this Ordnance Department achievement, not only factually but also with bits of human interest which I, being the young officer in the story, will recall. Christmas morning, 1917, found a young American officer calling at the office of the French Minister of Munitions. He had come to Paris the evening before from Chaumont, where he had the good fortune of serving on the staff of Col. C. C. Williams, Chief Ordnance Officer, A.E.F.

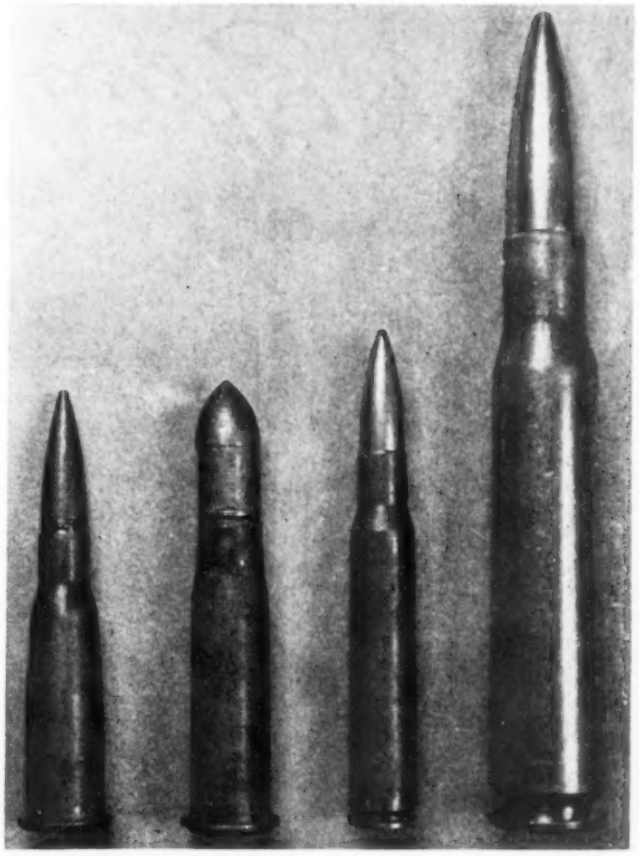
The duties of this junior officer took him among the French troops and to our First Machine Gun School at Gonducourt. At this latter post he had listened to the demands by Col. John Henry ("Gatling Gun") Parker, stated in his usual no uncertain terms, for machine guns of longer range for ground barrage fire than possible with our caliber .30 ammunition. Among the French troops he had witnessed the ineffectiveness of their Hotchkiss 8-mm. incendiary machine-gun bullet against the Boche hydrogen-filled observation balloons; and he had gained information that the French were working on a new "hush-hush" weapon for that purpose. He wormed out of a particularly friendly French liaison officer that this weapon was to be a larger caliber Hotchkiss gun, firing the conventional type phosphorus-filled incendiary bullet but containing more of that material. (See illustration for types of bullets mentioned.) He found out that two such guns had been made and tested in service, and he unofficially located the French Army units which had tested the guns and checked on the report of their performance.

This young officer then reported his findings to Colonel Williams, who, after listening with his usual quiet interest, said that the larger caliber (approximately ½-inch) machine gun, might have great further usefulness. He saw the future growth in aircraft and instructed the officer to pursue the matter further with the French. So the officer went to Paris on Christmas Eve.

The French Ministry of Armament looked up their records and disclosed that one of the two guns tested at the front had just been returned to Bourges Arsenal for inspection. The commandant of the arsenal was telephoned that an officer from the American Army headquarters would be at Bourges the next day, that he was to be shown the gun and test records, but that the gun could not be taken away. The next morning the American officer, knowing from experience that in his Army the Air Corps was more liberally supplied with the comforts of life, proceeded at once to their headquarters in Paris and there secured one of their small Fiat staff cars with a noncom to drive. He wanted an automobile because he thought there might be a gun to be carried back. Weather reports indicated fresh snow over the mountains, so a shovel was put on board as well as two spare tires. They started out that afternoon for Bourges and ran into the predicted snow storm, but they limped into Bourges on two flat tires the following day.

The officer found the colonel commanding the arsenal to be true to the best French Army type—courteous, friendly, and anxious to help the Americans. The gun was taken down and inspected. No excessive wear was found. The firing records were studied and the gun had functioned normally. The ballistics were good, although the muzzle velocity was rather low. The colonel was pleased that the Americans thought well enough of the gun—he had been concerned with its conception—to want one for shipment back to the United States. He telephoned the Ministry of Armament and persuaded them that Bourges Arsenal had obtained all that could be learned from the test gun, and that it should be turned over to the Americans. Permission was granted. The gun was reassembled and cased. But then the American officer found himself without transportation back. No tires could be found for the Fiat car, the punctured ones were beyond repair, and he didn't want to wait for spares to be sent down from Paris. Every space was sold out in the one night express train. The local train was apt to run a day late. But again the good colonel came to the rescue. A telephone call to the stationmaster soon convinced the railroad that an extra sleeping car should be put on for the American officer with his urgent matériel of war. He was on an important mission from the American Grand Quartier-Général, and with special permission from the Minister of Armament. The car, a Wagon-Lit, was provided—without heat, full of cinders and drifting snow—but it got the officer and gun back to Paris overnight. From there a staff car going up to Chaumont brought the two home again.

Next came a reinspection of the gun and records, a summary for Washington, with the gun, and a cable over General Pershing's name urging immediate construction of a machine gun of similar caliber but of higher velocity. We know what splendid results were reached in the years following and the place now occupied by our caliber .50 Browning in this war.



(Left to right) **Hotchkiss 8-mm. incendiary machine-gun cartridge; Hotchkiss cartridge with large incendiary bullet; U. S. cal. .30 machine-gun cartridge; U. S. cal. .50 machine-gun cartridge.**

Doctor Allen, now secretary and director of the Franklin Institute, Philadelphia, was a captain in the Ordnance Department in World War I. He also served in the machine-gun and small-arms section, Office of the Chief of Ordnance.

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From The Record

TANKS—AMERICAN VS. GERMAN

Last week the old question of the relative performance of the German and the American and British tanks came up for discussion. Some comments from close to the battle front spoke frankly of the greater power of the Mark V and Mark VI and with some disparagement of the Sherman and Cromwell tanks of the allies. The war map today has already answered the question, for the Germans who fell back before the Americans in western Normandy were driven back by armor.

The critics of American tanks are not completely wrong. Mark VI is more heavily armored than the Sherman and carries a heavier, high-velocity, long-range gun. If the Sherman were to stand still in front of a Mark VI and slug it out, it would be a weaker tank. But the Sherman doesn't stand still; it's a much swifter and more maneuverable tank, and while some Shermans carry lighter guns than the Mark VI, most of them carry guns that are able to pierce the Mark VI's frontal armor—which is what matters. The Mark VI towers high and presents a big silhouette and not much speed, and it consumes more gasoline, and it doesn't carry as much ammunition as the Sherman.

Our tank generals know all about the Mark VI. They know all about heavy tanks; in fact we made some heavy tanks in 1941. We made some pretty much like the Mark VI, and we stopped making them because the tank generals, while they wanted adequate firepower, also wanted great maneuverability. They preferred the Sherman when they might have had the Mark VI. Their reasons would be clear to a fight fan who was asked to choose between a lumbering, hugely muscled heavyweight who could crush a man who would stand still to be crushed and the light-footed middleweight with a punch in either hand but the ability to move in and to deliver a blow and to move away to escape one.

There's no question that our Ordnance Department can design and deliver anything within reason that tank generals want. The tank generals wanted the faster tank so long as it could pierce the armor of the heavier tank—and they have it in the Sherman. There are some Shermans with only 75-mm. guns which don't have enough power to pierce the frontal armor of the Mark VI at all ranges, but three other types can. These are fitted with the 3-inch high-velocity guns—the so-called 17-pounders—then with 90-mm. guns of high velocity, and with 105-mm. howitzers. These three types can pierce the frontal armor of the Mark VI and knock it out. We encountered the Mark V and VI with their 88-mm. guns in quantity in Africa and Italy, and the Shermans beat them there. Even the 75's can knock out the Mark VI if they can hit it from the side which its greater mobility made possible.—*Raymond Gram Swing, radio commentator.*

THE WAR IS NOT OVER

This is a bloody and brutal war, as bloody and brutal as any in the world's barbaric past. And it's not over, not by a long shot. We have a tough job still ahead of us in the Pacific as well as in Europe.

We know for a fact that our enemies bank heavily on the American people's losing interest in this war. The Japanese, in particular, feel that they will be able to salvage the greater part of their empire simply by prolonging hostilities—working for a draw.—*Gen. H. H. Arnold, Commanding General, Army Air Forces.*

New Developments

OUR ASSAULT TANK

The fact that America does have a heavier model tank in the field against the Germans has been officially confirmed by Maj. Gen. L. H. Campbell, Jr., Chief of Ordnance. The weapon is an "assault" version of the M4 with considerably thicker armor than the regular General Sherman tank.

General Campbell, reporting some first-hand experiences after his trip to Europe, stated that he had talked to a sergeant who had taken the assault vehicle into battle who told him his tank had been hit by a number of shells from a 73-ton Royal Tiger, all of which failed to penetrate. The American tank then destroyed the German vehicle.

NEW ORDNANCE WEAPONS ANNOUNCED

The Ordnance Department of the Army is at present directing over 1,300 major development projects on new and improved weapons. Col. S. B. Ritchie, assistant chief of the Ordnance Research and Development Service, has announced that approximately thirty new weapons are made ready for production each month.

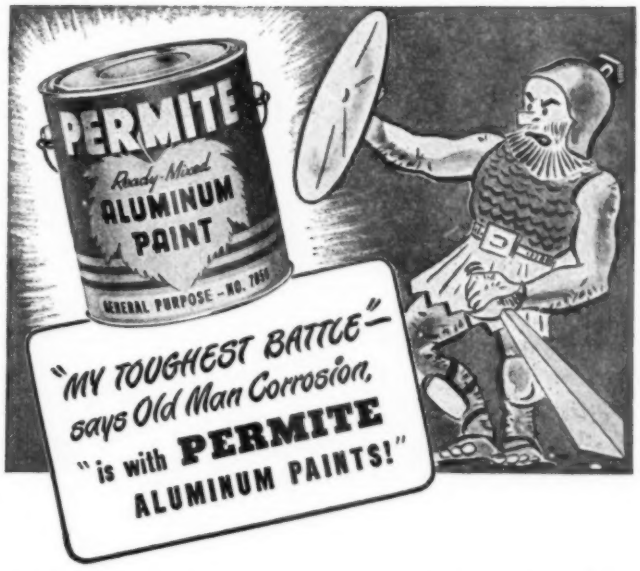
"One of the outstanding accomplishments in shoulder arms of this war," Colonel Ritchie declared, "is the development of multiplicity of functions. New rifle grenades, for example, have been designed for antitank, antipersonnel, incendiary, smoke-screening, and signaling purposes.

"The ammunition field has been greatly expanded and improved. A few items may be mentioned: antitank and antipersonnel mines (magnetic and nonmagnetic) and their opposite mine-field clearing devices; sparkless-noiseless-flashless fuzes for grenades; a whole series of 20-mm. ammunition, including high-explosive, armor-piercing, and incendiary; the finest and most powerful demolition and fragmentation bombs in the world; new incendiary and chemical bombs; hypervelocity ammunition (fitted with tracers so that the gunner can follow the path of the projectiles); a whole series of identification signals and flares for air and ground use; smoke ammunition in all calibers of field artillery; a combination of powder composition and primer to produce a minimum of smoke and no flash; the elimination of flash in big guns; a whole series of grenade signals and grenades, including smoke, fragmentation, and offensive types; a new type of concrete-piercing fuze which can be assembled to our *standard* high-explosive ammunition for artillery weapons in such a way that the projectile is transformed into a superior concrete-piercing shell, capable of blowing apart the strongest German pillboxes; mechanical delay and contact type bomb and artillery fuzes and other special fuzes; and illuminating shells for artillery and mortars of all types.

"The range of our artillery in general has been increased forty to fifty per cent over that of World War I.

"Miracles have been achieved in equipping our vehicles for flotation on the water and wading through deep water.

"The 90-mm. gun motor carriage M36 is an outstanding tank destroyer now being employed as effectively against German armor as in the days of the Saint-Lô break-through when it knocked out on an average of ninety German tanks a day. Our M36 mounts a gun more powerful than the German 88-mm. gun and can outmaneuver all types of the relatively slow-moving German tanks. This 90-mm. gun, with its ammunition, is one of the most accurate weapons ever built in this country."



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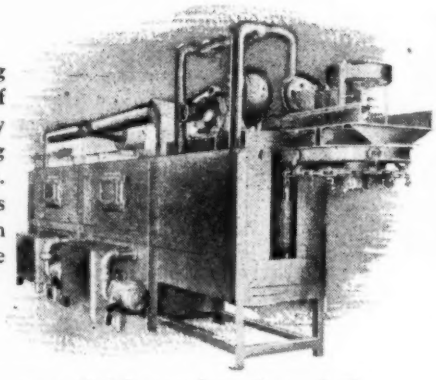
This A-F Cleaning Machine consists of wash, rinse and dry units for cleaning incendiary bombs. A vent system draws off all vapors from wash and rinse sections.



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New Developments

JET PLANES FOR THE NAVY

New fighter planes for the Navy employing jet propulsion are being developed which can travel as fast as sound—about 763 miles an hour—Rear Adm. D. C. Ramsey, Chief of the Bureau of Aëronautics, told the House Naval Affairs Committee. In discussing the new and novel features which have been incorporated in the Navy's planes, the "most spectacular of all," Admiral Ramsey said, "have been the numerous adaptations of electronic devices to aircraft use." Among the most outstanding of these, he added, is the advent of the night fighter.

ANTIGRAVITY SUIT

Pneumatic pants, which prevent fighter pilots from "blacking out" in aërial maneuvers against the enemy, now are worn in P-51's and P-47's of the Eighth and Ninth Air Forces, which are engaging the enemy in the European theater of operations.

Known as the G-suit (G meaning gravity), the new equipment applies pressure to the pilot's abdomen and legs during a pull-out or turn, thus preventing the blood from pooling in the lower extremities and helping the heart maintain circulation to the brain. The fighter pilot now can make tighter turns in level flight and sharper pull-outs from power dives than were hitherto possible.

NEW AMMUNITION MACHINES

Shell loading by hand is a slow process in which molten TNT is poured, cooled, hardened, and packed into shells a little at a time to prevent formation of air cavities that may cause premature explosion.

The Ammunition Division of the Ordnance Department has developed two new machines to do this job faster and better. One looks like a milking machine and hence is called the "mechanical cow." The other resembles twenty-four round bayonets slung under a steel bar and is known as the "hot bayonets" machine. Now being standardized at all Army Ordnance plants, they are expected to save five million man-hours this year and greatly speed up the production of needed artillery ammunition for our fighting forces.

In operation, the "cow" cools the exact amount of TNT to the correct temperature, then pours it through nozzles into twenty-four shells mounted on a carriage. After further cooling, the shells are probed by the steam-heated "bayonets" all the way down to the bottom, where cavities usually form. Then the "cow" adds more molten TNT until the shell is completely filled.

"WELDER-JEEP" FOR COMBAT REPAIRS

A highly mobile welding shop on wheels that can traverse ground which proved impassable to most previous maintenance vehicles has been developed by the General Electric Company, in coöperation with Army engineers, to enable emergency repairs of damaged war equipment to be made right on the field of battle.

Consisting of a standard Army jeep bearing a specially perfected arc welder, this mobile repair shop has proved invaluable in helping to keep front-line equipment in fighting condition.

In weight the welder jeep is equivalent to a ¼-ton truck, whereas the equipment it replaced consisted of a 5-ton truck towing a 1½-ton welding trailer. This weight reduction, plus the jeep's great maneuverability, enables the vehicle readily to negotiate rugged or muddy ground where larger and heavier trucks break down. When desired for use in air-borne operations, it can also be loaded aboard a transport plane.

FIRE CONTROL OF THE P-61

Closely guarded secrets about the powerful gunfire system on the P-61 Black Widow night fighter plane, including the fact that caliber .50 machine guns on a revolving turret can be

aimed and fired by gunners located in comparative safety many feet away, have been revealed by General Electric, designers and builders of this important equipment.

Two sighting stations, one in the front part of the plane and the other in the rear, can take over control of the gun turret, although primary control rests with the gunner in the forward station. If at any time the gunner in the rear blister wishes to take over aiming and firing the guns, he can do so, provided the turret is not being used by the front gunner, by grasping an action switch which relinquishes to him control of the turret.

OIL FOR THE YANKS IN CHINA

After two years of secrecy, American Army headquarters in New Delhi, India, announced that the main portion of a fuel pipe line which ultimately will reach from Calcutta to China across Burma has been completed. Already the pipe line, the longest military operational line in the world, is used to fill the gigantic tanks of Superfortresses in India, and one of its major tasks is to feed gasoline into the planes ferrying fuel to the Fourteenth Air Force in China.

SLIDING STOCK FOR THE CARBINE

Designed by J. L. Lockhead, ordnance engineer at Springfield Armory, a new collapsible stock for the caliber .30 M1 carbine makes it an ideal weapon for jungle fighting or air-borne operations as it reduces the weight of an already light weapon and also makes it easier to carry under combat conditions.

Ordnance

The caliber .30 carbine showing stock extended and closed.

The inventor, who was granted a patent on his device on October 24, 1944 (No. 2,360,881), claims that the advantage of this stock over similar ones is that it can be collapsed or extended quickly and that it remains rigidly fixed in the firing position.

HIGH-SPEED X-RAY PICTURES

A high-speed X-ray unit, capable of taking X-ray pictures as short as one-millionth of a second, is used at Frankford Arsenal to photograph rapidly moving projectiles in gun barrels. Designed by Westinghouse for ballistic studies, this unit requires about 2,000 amperes at 300 kv, or 600,000 kw for a microsecond. The tube can withstand these tremendous but brief floods of energy for a thousand pictures, but, at exposures of a millionth of a second each, the total service life is but a small fraction of a second.

Arsenals have been quick to apply this high-speed X-ray to determine the location of a projectile in a gun barrel with respect to the curve of gas pressure versus time, the effect of the rapid acceleration on the component parts of composite projectiles, such as explosive bullets, and the manner of progression of a projectile through armor. Pictures of actual armor penetration taken by ordinary photographic means are obscured by luminous

HYDRAULIC PRESSES
Back the Attack

Watson-Stillman Press consolidating high explosives in projectiles at Mid-western ordnance plant.

Loading high explosive shells and armor-piercing bombs to help deliver the "knockout punch" to the Axis, Watson-Stillman Hydraulic Presses are at work night and day throughout ordnance plants and other busy war industries backing the attack.

Among these presses is the Watson-Stillman unit shown consolidating high explosives into projectiles at a Mid-western ordnance plant. This ammunition-making equipment takes its place beside many other Watson-Stillman Hydraulic Presses which are packing war wallops – some straightening gun barrels – some bending the keels of ships of our invasion fleet – others forming aircraft parts, re-conditioning railroad rolling stock, molding ceramics and plastic products, pressing powdered metal, extruding, forming and forging metals, and innumerable other operations. Write for General Bulletin 110-A.

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fragments created by impact. One of the surprising facts revealed by these X-ray pictures taken in a millionth of a second is the swelling of explosive shells to almost twice their normal diameter before they burst.

THE P-38 LIGHTNING, MODEL L

Revolutionary air compressibility flaps, hydraulic aileron booster control, and added power through use of a new supercharger device have increased combat deadliness of the P-38 Lockheed Lightning, already the world's most formidable and versatile warplane. The "On to Tokyo" Model L Lightning can carry a bomb load of 4,000 pounds, 50 per cent greater than the previous model. Present bomb capacity arms the Lightning with a striking power greater than that of the early Flying Fortress.

Speed of the Model L has been boosted six per cent or "faster than" 425 miles an hour.

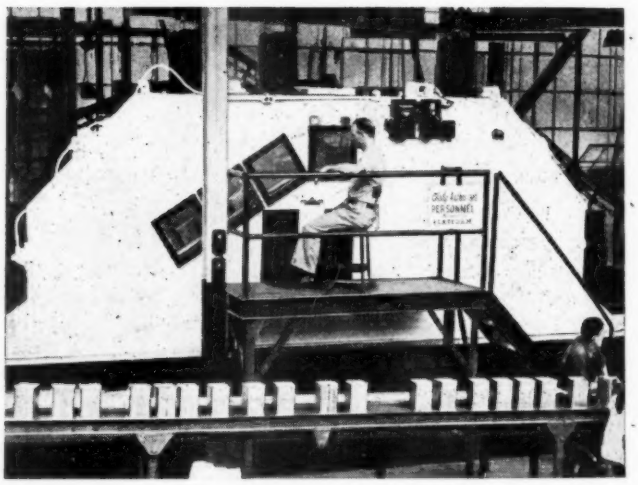
A NEW SYNTHETIC RUBBER

A new synthetic rubber, which looks like and is as pliable as soft putty but which, contrary to characteristics of ordinary rubber, loses none of its elastic qualities at temperatures as low as 60 degrees below zero and as high as 575 degrees above, has been announced by the General Electric Company. It is known as silicone rubber, and can be stretched like taffy or chewing gum; yet when rolled into a round mass will bounce as well as, if not better than, any ball made of the best rubber.

CARTRIDGE CONTAINER TESTER

A machine for vacuum testing the waterproof qualities of metal containers for caliber .30 and .45 ammunition has been designed by R. H. Dickman, an engineer at Chrysler Corporation's Evansville Ordnance Plant, Evansville, Ind. Known as the "Vacuveyor," the machine, shown in the accompanying illustration, can test 780 metal cartridge containers an hour. It is 45 feet long, 5 feet wide, and 13 feet high.

The metal cans containing ammunition enter the machine at



The "Vacuveyor" for testing cartridge containers.

the left and travel on a conveyor through a water-filled enclosure. Imperfect cans, emanating bubbles as they travel through the vacuumized chamber at the top of the machine, are spotted by the operator who observes them through strong plastic windows. He then identifies them for rejection as they travel toward the exit conveyor belt at the right.

The machine has been so successful in identifying inferior cans for rejection or reëxamination that the Government has adopted it for tests in other small-arms plants. With a few alterations, the machine will handle 1,200 cans an hour.

Automotive Maintenance

ORDNANCE REPAIRS TIRES TOO

What is believed to be the largest tire-repair shop overseas is being operated by an Ordnance Tire Repair Company in Italy. The company is commanded by Capt. M. L. Shreves of Bloxom, Va. This company turns out during a regular 30-day operating period an average of 534 tires a day, some of which receive 3 separate repair operations. In 24 actual operating days, 12,806 tires were completed by the company. One repaired tire rolls off the assembly line in every two minutes and fifteen seconds of operating time.

During the present critical tire shortage, the value of the work being done by this company is immeasurable. Many trucks used for the transportation of vital supplies to the Italian front are now using recapped tires. Many low-lift machines, which are used in unloading ships and placing items in depots, were deadlined for lack of tires until the Ordnance company started repairing the size which they use. Road-grading machines depend entirely on repaired tires.

The company personnel consists of 5 officers and 140 enlisted men. An average of 145 Italian civilians and 60 Italian soldiers are employed each day. Most of the Italian civilians were originally local farmers.

The following figures are an extract from the operation records of the company, taking a 30-day month, with 24 actual operating days: Tires completed, 12,806; tubes repaired, 9,984; tires inspected and classified, 30,673; tires shipped, 60,186.

The tire shop was opened at its present location on July 7, 1944. Floor space under roof was 15,960 square feet. The first repaired tire was finished on the opening day. This tire has been retained by the company and is called the "Two Million Dollar Tire," since it is estimated that the cost of the machinery, the training of the personnel, and the cost of moving personnel and machinery would amount to practically that figure. One hundred and fifty-six tires were repaired the first day of operation. Waiting to be repaired at that time were approximately 65,000 tires of all sizes.

DURING the month of July, 5,154 tires were completed. The shop was run on a 24-hour schedule and production was increased as the Italians began to learn their duties more thoroughly. To train one of these Italians to do one operation required approximately two weeks. In August, production increased to 11,190 tires completed, many of which required 3 separate repair operations, such as spot, section, or reënforcement repairs, before a full recap could be applied. It is estimated that if each tire required only one repair operation the shop could have turned out 1,200 tires a day instead of the regular monthly average of 534 tires a day.

In September, the shop only operated seven days due to lack of material. During this period of waiting, the company took over the operation of the compound where tires to be repaired are stored, previously operated by another unit. There were 105,119 tires in the compound on that date.

Materials arrived during the first days of October, and production was resumed on October 4th. Nine thousand tires were repaired in the remaining days of that month. Production since that time has been uninterrupted. Production data for the period July 7th to December 14th reveal that 48,769 tires were completed, requiring more than 80,000 operations, and that 6,474 units were retreaded.

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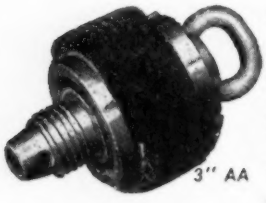
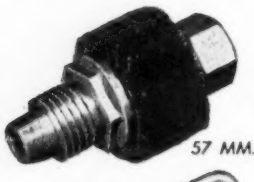
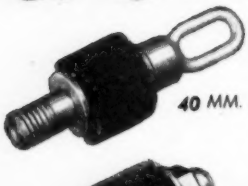
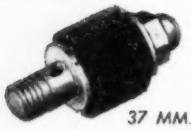


Above is shown the popular 155 mm. brush such as is used for the famous Long Tom Gun. Other size brushes are used for anti-aircraft batteries, tanks, and pack howitzers. Brushes are also provided for cleaning breech mechanisms and elevating gears.





Fullergript Brushes are made to Naval Gun Factory specifications from the one-pounder size up to the six inch gun.



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PROFESSIONAL DIGEST

ORDNANCE "THINGAMAJIGS"

Every one has heard of a "thingamajig" but very few people have ever built one. A Peninsular Base Section Ordnance shop, however, has made a habit of inventing them, and the result has been decreases up to seventy-five per cent in time used for repairs.

"The Army supplies us with machines and tools," M. Sgt. Albert Degner, shop foreman from Salem, S. D., said, "but we're always running into jobs that call for something we haven't got."

The Sergeant's outfit, the 603rd Ordnance Base Armament Maintenance Battalion, sponsored by the National Automobile Dealers Association, started repairing guns and combat vehicles for the American II Corps while it was fighting in Tunisia, and it was there the men first saw the unusual problems arising when equipment is used in combat. Weapons which had been tested in the United States needed modifications to make them practical for desert fighting, and these men had to make the necessary changes in a hurry.

"We made filters to keep sand out of motors, fixed ack-ack guns that were clogged up with dirt, and did a dozen other little jobs in addition to major repairs," Sergeant Degner said. "Most of our men were skilled mechanics in civilian life, so just about everybody contributed to the program."

The Army's books and manuals didn't say anything about how to pile motors weighing over a ton one on top of the other or how to keep the jaws of a wooden vise from tearing apart when they had to work on a rusty gun. But whenever a problem arose some soldier got an idea for a "thingamajig," and the solution was found.

Tech. Sgt. Clarence Krob of Minneola, Kans., who used to be a deputy sheriff, farmer, and auto mechanic, has watched his small-arms section grow into a large armament shop in twenty-two months overseas. He has installed mass-production methods for disassembling broken rifles and machine guns picked up on the battlefield and simplified operations so that Italian labor could be employed on a large scale. New guns are built from parts that may have come from four useless, damaged weapons.

"One of our biggest problems was completing the modification on the American carbine," Sergeant Krob said. "A new sight had to be put on every carbine in the theater. We needed an automatic vise to cut down unnecessary handling, so we built one from a hydraulic truck jack that cut operating time in half. Now we do alterations on more than 1,000 carbines every day."

A competitive spirit has flared up among the sections, according to Sergeant Degner, and they all have added their "thingamajigs" to the outfit's collection.

The artillery section tows the Fifth Army's huge guns around the artillery park and shop with a German "blitz buggy" picked up to T/3's Robley Stooky of Salt Lake City, Utah, and Chester Johnson of Wichita, Kans., at Cape Bon at the close of the North African campaign. The German vehicle is about six feet long with caterpillar tracks instead of wheels.

"It's a powerful little tractor," Sergeant Degner explained, "but it breaks down occasionally. Our machinists have taken broken German gears, blueprinted them, and built new ones out of scrap metal as well as other parts so that now the 'blitz buggy' is almost an American-built machine."

Contributing its share, the automotive section has built wreckers out of jeeps, using them to move motors, transmissions, and

all the other things too light to be moved by crane and too heavy to be moved by hand. The job involved reënforcing the jeep's frame, building a boom, and installing a power winch taken from an amphibious jeep.

"Our jeep wrecker idea has spread to other outfits since we built our first one in Africa," said Sergeant Degner. "We've driven most of the half dozen wreckers over 20,000 miles, and everywhere we've gone some one has copied the idea."

A machine for modifying the bogie wheels on half-tracked combat vehicles was designed and built by M. Sgt. Alfred Tronstad of Shelby, Mont. It has made a 15-minute job out of one that used to take two hours. This machine held the mythical shop championship for "thingamajigs" until Tech. Sgt. William Norman of Terre Haute, Ind., built a mobile crane out of a ¾-ton truck so that tank motors can be unloaded from trucks and stacked in piles in one-fourth the normal time.

"Men from our outfit have done almost every kind of ordnance work overseas," Sergeant Degner added. "They've worked with the Navy installing antiaircraft guns on ships, with the Air Corps installing aërial guns on planes, with antiaircraft battalions in the field, and with the artillery at the front. The best part is that each job they've had has resulted in some kind of improvement either in the shop or on the spot."

AMERICAN JET ENGINE

The first jet-propulsion engine in this country free from foreign influence is under development at Westinghouse for the Bureau of Aëronautics, Navy Department. When the development is completed, this new engine is expected to produce more pounds of thrust for a given amount of fuel and pounds of weight than any engines brought from Europe for study. This engine is expected to be important for future aircraft service.

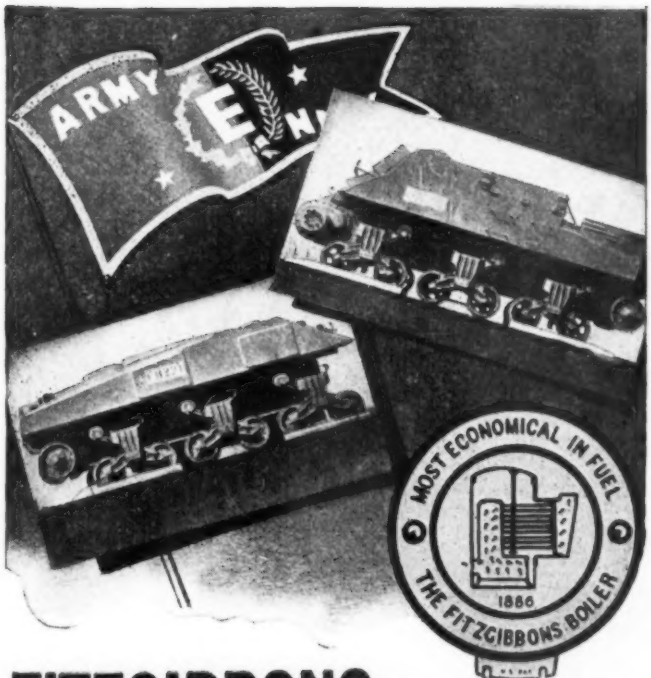
Few subjects in recent years have been studied so assiduously, few have commanded so much research work, so much laboratory experimentation as gas turbines, of which jet-propulsion engines are but one form. Actually, an enormous amount of ground has been covered. Probably more has been accomplished in the past two years to make the gas turbine widely practical than in all previous history.

Essentially, work of three sorts is being done. One is in the field of high-temperature metallurgy, because the success of the combustion gas-turbine cycle depends on the temperatures in the turbine itself being 1,200 degrees Fahrenheit or more, which is well beyond the highest steam-turbine temperatures. The higher the allowable temperatures, the greater the efficiency and the wider the field of usefulness of the gas-turbine cycle as a prime mover.

A second and the most active phase of the activity is the design, building, and testing of different units with many variations as to size and arrangement. This includes designs for the three main components of a gas-turbine cycle—axial-flow compressor, combustor, and gas turbine—and the relatively few but important controls and auxiliaries.

A third activity—sharply limited by more pressing war work—is the investigation of possible uses of the combustion gas-turbine cycle. This involves extensive thermodynamic and heat-balance calculations for a wide variety of simple open-cycle systems, heat-recovery open-cycle systems, and closed-cycle systems—all predicated on assumed efficiencies, loadings, and costs.

The great attraction of the combustion gas-turbine cycle lies in its simplicity and independence of a water supply. Basically it consists of three units on a single shaft. Liquid fuel is burned with a great excess of air in a combustor. The hot products of combustion drive a gas turbine and, in the simple cycle, exhaust to the atmosphere. The turbine develops power to drive an axial-flow compressor on the same shaft that supplied air to the combustor. Power from the turbine in excess of that required by the compressor can be utilized to drive a generator or some other mechanical load.



FITZGIBBONS WAR RECORD

As another war year dawns, it finds Fitzgibbons maintaining the production pace which has earned to date three Army-Navy "E" awards. On every fighting front—and on the home front, too—equipment by Fitzgibbons is giving battle or serving vital military needs.

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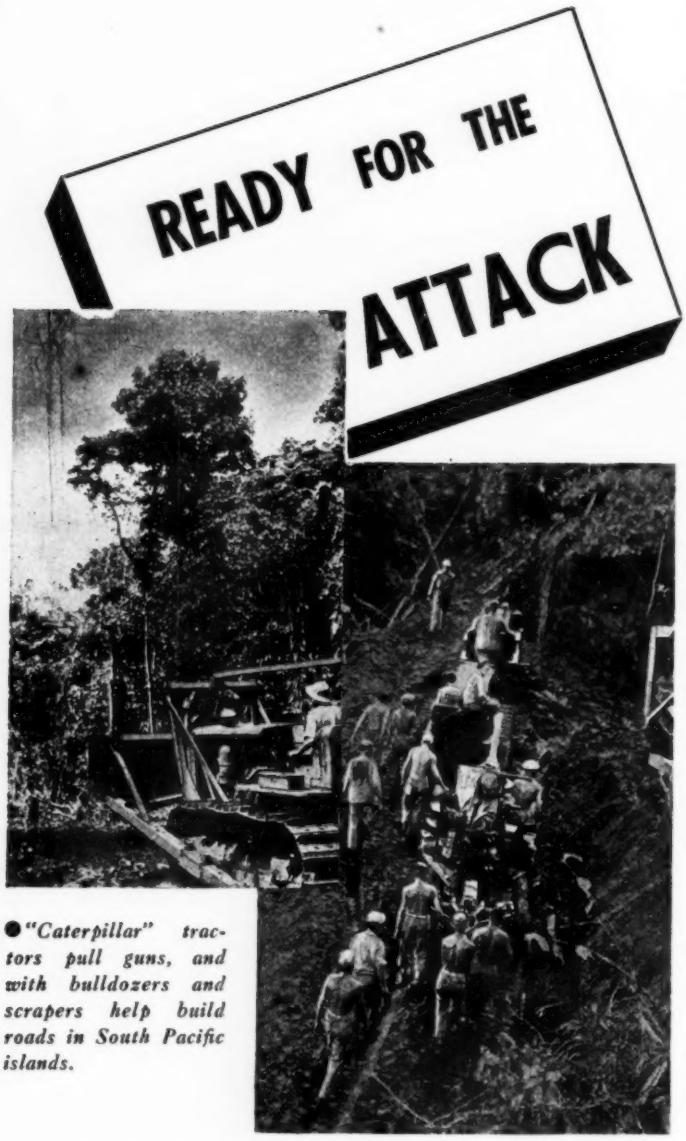

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Professional Digest

The efficiency of a 1,200-degree-Fahrenheit simple open-cycle gas-turbine plant is about twenty per cent, which is only about two-thirds that of a good steam or gasoline-engine power plant. Also all present combustors and turbines require liquid fuel. The unit, furthermore, is not self-starting. But it is simple in form, is small in weight and bulk, requires no water, and is a rotating device. Efficiency can be increased 10 or 15 per cent by adding various heat-recovery devices such as intercoolers for the compressor, regenerators for the combustor, and fuel reheaters.

CUB PLANES NOW ROCKET-ARMED

Back in the days when hedgerows were being featured in the news and when the American Third Army was shifting into high gear down the Cherbourg Peninsula, a handful of Nazis got the surprise of their lives. Two German cargo trucks were speeding down a highway several miles ahead of an American tank column. An innocent-looking Piper Cub artillery spotter plane from the 4th Armored Division cruised lazily above them. The Germans, having no fear of what they thought was an unarmed spotter plane, raced on. But they didn't race far. A projectile which had been fired from the plane hit both trucks, setting one on fire. The Germans fled in panic to the woods. Later, American tanks captured the soldiers and their deserted vehicles.

No longer does the enemy pass off the Artillery's Grasshoppers as only the harbingers of future trouble. They are now regarded as a positive on-the-spot menace. Armed with rocket-firing bazooka tubes beneath their wings, the once-harmless Piper Cub planes, with their high-explosive 2.36-inch bazookas, have become little sisters to the Army Air Forces' Thunderbolts and the Royal Air Force's Typhoons.

Lieut. Harley Merrick of Richmond, Calif., and Lieut. Roy Carson of San Francisco, Calif., two pilots whose job it is to adjust artillery fire from the air, dreamed up the novel weapon during training in England.

"We figured we ought to have something to shoot with," recalled Lieutenant Merrick, "and since a machine gun was too heavy for our type of small plane, we got four bazookas from an Army Ordnance depot and went to work."

The Ordnance bazookas were stripped of sights, grips, triggers, brackets, and flash deflectors—only the bare tubes remaining. They were then attached to the undersides of both wings, and an electric trigger was rigged in the cockpit, enabling the pilot to fire the Ordnance bazookas singly or simultaneously.

"Fearing the blast might set fire to the plane's fabric," said Lieutenant Carson, "we tried out the rig on the ground first. It worked, so we took our ships upstairs and shot at some old British tanks. The tanks took a beating and we didn't, so we figured we had something."

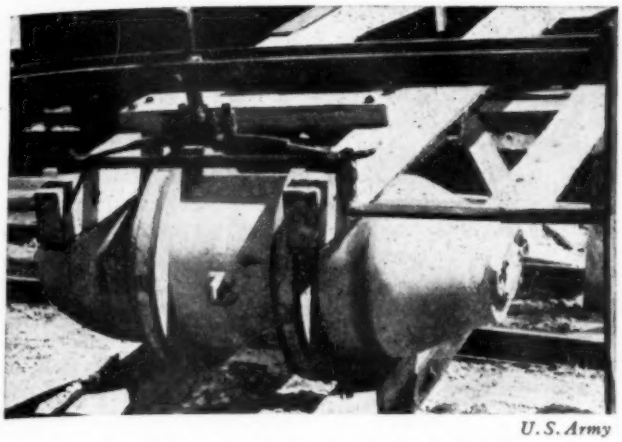
The bazooka style of the Grasshoppers may not be as grand as that of the rocket-firing fighter planes, but the results gratify the pilots who otherwise would have to "sit and take it" from everything in the German Army's antiaircraft artillery.

BOWLING ALLEY FOR BOMBS

A bomb bowling alley which delivers 500-pound incendiary bombs direct from freight cars to open-air storage racks is the latest thing in safety appliances developed by the Chemical Warfare Service. By use of the contraption, workers at the Deseret Chemical Warfare Depot, Utah, unload and stack fire bombs as easily as a pinboy returns balls in a bowling alley.

The gadget consists of a wooden chute leading from the freight car door to a pair of wooden rails running along the ground. The bombs roll down the chute and along the rails into position. The railway also serves as a platform on which the rows of bombs remain piled. The secret of the bomb bowling alley is the chute, which regulates the speed of each bomb so accurately that it can be made to roll 2 feet or 200 feet before stopping.

At the Deseret Depot, freight cars bearing incoming shipments of fire bombs are backed up on a siding only a few feet from the storage area. The wooden chute is set up at the door and leads directly to the wooden railway which acts as the storage platform. The chute consists of two long wooden frames which clamp together over the bomb like a vise as shown in the accompanying illustration. Hinged at the freight-car end, the upper frame can be screwed down as tightly as necessary by means of a hand



U. S. Army

Braking device at end of the bomb chute.

screw at the bottom end. Strips of brake lining glued to the upper frame increase the chute's braking power.

Acting as pinboys on the bomb bowling alley are the workers in the freight car. As they feed the bombs into the chute, the pressure is gradually increased: the first bomb picks up enough speed to roll to the end of the railway; the second bomb moves more slowly, losing momentum as it comes to rest against the first, and the remaining bombs are bowled in similar fashion including the last bomb in the row.

Previously it has been necessary to remove each bomb from the freight car with a fork lift truck, load it onto another truck, which then drove to the end of the row and set the bomb in place on the stack. This method involved the danger of muscular strain in handling the heavy incendiaries and of serious injury in case one of the bombs slipped and fell. With the bomb bowling alley, Deseret workers are saved from these hazards, and they are able to stack five times as many bombs in an hour as previously.

ROCKETS FOR THE NAVY

The Navy shortly will be spending $100,000,000 monthly on rocket ammunition alone. Rockets have been found increasingly useful, among other things, for spraying death upon Japanese machine gunners as a cover for landing operations.

The $100,000,000 outlay, to be attained within four months, is "as much as is now being spent per month for all types of naval ammunition," according to the Office of War Information. The Army is down for about $12,000,000 monthly throughout 1945 for rocket ammunition, over and above the amount spent on the projectors themselves.

Indication that America may have some rocket surprises in store for the Axis was given in this OWI comment: "Newest American rocket developments, including design details and the range and speed attained by the projectiles, as well as production figures, have not been made public by the military authorities."

Noting that Ordnance experts have not officially reported any giant long-range projectile like the German V2 rocket bomb (see p. 236), OWI said: "American Ordnance experts have concentrated on developing artillery-type rockets, with emphasis on correcting the present relative inaccuracy of rocket fire."

AIR FORCE G. I.'S CALL THESE HEAVY-DUTY AUTOCARS "QUEEN MARYS"

Yet, strangely enough, the tractor they call "Queen Mary," after one of the biggest ships afloat, is the *smaller* of two sizes of military tractors that have been rolling out of the Autocar factory in increasing numbers all through the war. Heavy loads and heavy going mean little to Autocar two-, four-, or six-wheel-drive trucks and tractors.

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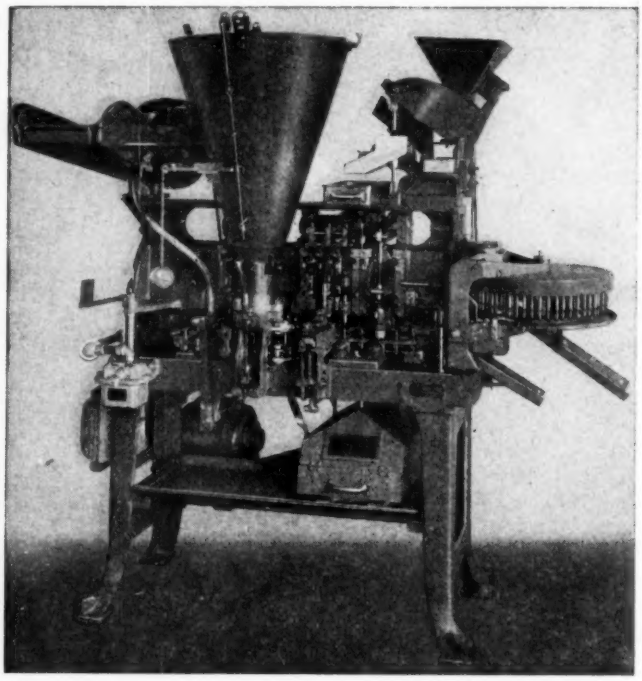

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BOOK REVIEWS

FIREARMS OF THE CONFEDERACY. By Claud E. Fuller and Richard D. Steuart. Huntington: Standard Publications, Inc. 333 pp. $12.50.

THIS work should have appeared not later than 1900, at which date a man twenty-five years of age in 1865 was already sixty. And Confederate arms makers were not generally young men. As often reiterated by Fuller and Steuart, Southern youth was denied exemption from the draft even for work in munitions plants. Hence the majority of those closely familiar with the arms story were nearer to 40 than 25 in 1865, and to 75 than 60, in 1900.

Thus the present authors have labored under the handicap of time irreparably lost, and gone with it men and documents that could have solved many of the riddles now presented—and left partly or wholly unanswered. Despite this they have gathered a fascinating mass of data which will serve forevermore as a reference work for the student of Confederate small arms. If this is the worst offering on the subject, as it undoubtedly is, by the same token it is the best as well, for it has no competitor.

To those familiar with Civil War history, many of the incidents recorded in this volume will not be news. But to others they will constitute revealing sidelights on the confused political situation of the day. One of these concerns the failure of the Federal Government, as late as mid-April 1861, to make the least gesture toward supplying an adequate defense of its vitally important Harpers Ferry Arsenal, seized by the Confederacy, April 18, 1861. A suitable force, sent from Washington, could have reached Harpers Ferry in a matter of a few hours. The post was in hostile territory, in imminent danger of attack, and the veriest moron could appreciate its military importance. Why then was nothing done to reënforce its pitiful garrison?

Another matter excellently treated is the age-old discussion as to who merits credit for perfecting the manufacture of arms on a truly interchangeable basis. Of the three candidates for this honor—Whitney, North, and Hall—Eli Whitney has commonly been accorded precedence. Roger Burlingame's recent volumes[1] have especially served to establish him in the primal position. But Mr. Fuller (pp. 66-69) builds such a sound case in favor of the third contender (John H. Hall) that I for one am obliged to switch my allegiance to that gentleman. Remember, *priority* in the manufacture or attempted manufacture of truly interchangeable arms is not here at issue—it is common knowledge that the system originated in France—but rather a decision as to who first met complete success in such an enterprise.

Fuller also gives (pp. 76-80) an expert résumé of the "Hall Carbine Affair." Every hireling hack commissioned to besmirch the munitions industry or banking interests has rattled this moldy skeleton for lo, these many years. The facts in brief, as expounded by Fuller, are that the U. S. Chief of Ordnance, James W. Ripley, authorized, as late as the spring of 1861, with the Civil War practically in being, the sale of 5,000 Hall's smoothbore percussion carbines, weapons then obsolete but wholly serviceable. The unit price was a modest one—$3.50. A speculator, A. M. Eastman, promptly bought them and, before he had actually taken delivery, resold them to one Simon Stevens at $11.50 each. Stevens borrowed $20,000 from J. P. Morgan, the

[1] "Whistling Boy," New York, 1941; "March of the Iron Men," New York, 1942.

elder, to finance his deal. Thirty-eight days later he paid Morgan in full, and the latter passed from the picture.

Meanwhile Stevens had had the weapons rifled at his own expense and resold them to General John C. Frémont (for issue to his troops) at $22 each. Thus the Government took from its right hand and sold to its left at a handsome profit to the middlemen. Morgan, who has constantly been painted as the bloody-handed fiend who engineered the transaction, had nothing to do either with the purchase or sale of the weapons and ". . . in the congressional debate [on the scandal] his name was mentioned only once, and then only to emphasize his circumscribed interest."

Pages 82 to 95 of Part I are devoted to a discussion of George W. Morse, his devices for converting muzzle-loaders to breech-loaders, his services to the Confederacy, and his activities from 1854, when the Government first took serious cognizance of his inventions, to his death in 1888. As the man who developed the first successful center-fire cartridge in this, or probably any other, country, Morse has long deserved more recognition than he has been accorded. Mr. Fuller is to be congratulated upon having shed new light upon the life of this remarkable individual.

THERE is an occasional spark of humor in the otherwise sometimes humdrum recitation of facts and figures. Thus we find on page 48 a letter dated November 24, 1860, from one S. Adams, master armorer of the Virginia State Armory, addressed to J. B. Floyd, United States Secretary of War, and written from Springfield, Mass., where an indulgent Federal Government was permitting this representative of a hostile state to study its arms-manufacturing methods and to make drawings of tools and fixtures! Adams makes no bones over the fact that he realizes that the courtesies being accorded him in Springfield are due to Floyd's Southern sympathies and says naïvely: "I have no hopes of any assistance after a Black Republican takes possession of the War Department."

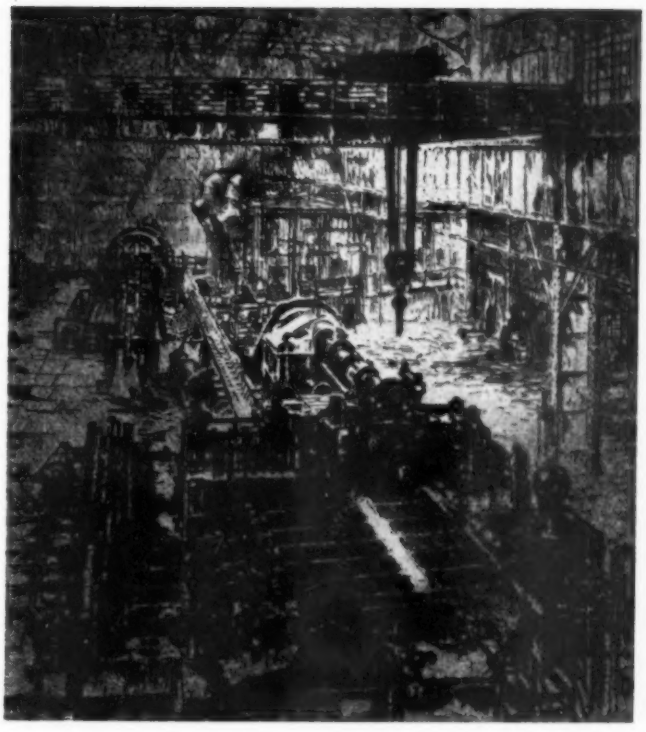
Another letter, unsigned, dated at Tyler, Tex., June 24, 1864, and addressed to the editor of the Galveston *Weekly News*, is reprinted on page 143. Speaking of the activities at a certain Confederate arms manufactory, the author observes, evidently with surprise and pleasure: "Though this is a [Confederate] government establishment, I did not see one idle man about the premises. . ." Plainly, the good old practice of "gold-bricking" among those feeding at the public trough antedates the twentieth century!

That the militant spirit of the times spread even to the Southern clergy is evidenced in a letter printed on pages 251-252 which states in part: ". . . we had the pleasure of examining a Colt's repeater [*i.e.*, revolver] which was made by the Rev. Felix Johnson. This weapon was complete in all its details and appointments and as well calculated to do damage as Mr. Colt's best."

We find evidence that the Confederacy experimented with producing small arms by convict labor, apparently to its sorrow. Thus in a letter from W. B. Wernac, master armorer at the Georgia Armory (located in the State Penitentiary at Milledgeville) dated February 28, 1863, and addressed to a legislative committee of the State of Georgia (anent a proposal for rebuilding the armory, burned by General Sherman), there appears (page 177): "I would . . . suggest that there ought to be no connection whatever with the Penitentiary. The past has furnished sufficient evidence of the incalculable injury the State Armory has sustained by its introduction within the walls of that institution."

ANOTHER matter of great interest discussed by Fuller is the relatively free traffic in small arms between Northern manufacturers and Southern buyers which persisted until late in the Civil War. Thus he records (p. 240) the sale by Colonel Colt in March 1861 of 500 "Navy" revolvers[2] to the State of North

[2] The "Navy" caliber was .36, the "Army," .44.



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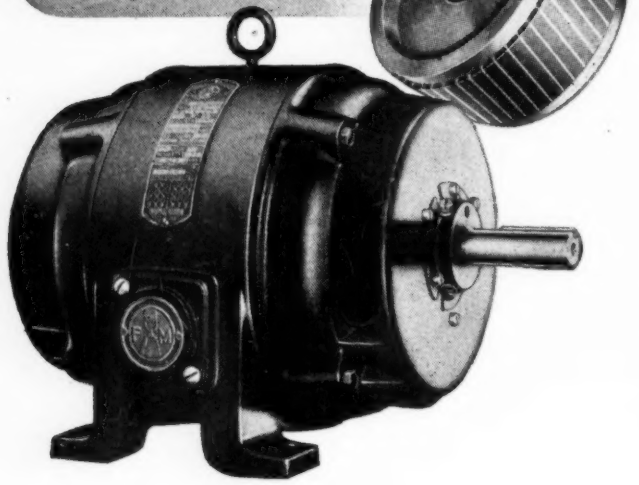

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Book Reviews

Carolina, while during May, June, and July of the same year, Richmond and Petersburg arms dealers were advertising newly received stocks of Colts. And as late as Christmas Eve, 1863, there was seized in New York harbor a steamer about to sail (evidently for some blockaded port) with fifty kegs of "lard" in her hold. Opened, these revealed not lard but more "Navy" revolvers. Earlier in 1863 the Confederate General Bee reported (p. 244): "I am informed that carbines and pistols can be had; bought in New York and shipped to Brownsville [Tex.] without trouble. Am offered 5,000 Colt's revolvers at $25 for the Navy size and $38 Army size."

It seems that Eli Whitney was also among those approached by Confederate agents, to whom he agreed to supply 1,500 rifles of Enfield pattern, 1,000 to be delivered by December 1, 1860 (p. 80). But the canny Yankee delivered only "...old guns fixed up," and the contract was canceled.

One of the most generally informative items in this work is Gorgas' summary of ordnance activities within the Confederacy (pp. 112-131), as previously printed in ARMY ORDNANCE and elsewhere. Unfortunately, this is the only such document spread upon its pages. Thus no mention is made of the well-known "History of the Confederate Powder Works" by Col. G. W. Rains,[3] nor of the humorous, though scarcely printable, poems evoked both South and North by the activities of the Confederate "Mining and Niter Bureau," though the Rains monograph and the ribald poetry have probably gained much wider circulation over the years than has Gorgas' report, despite its several printings.

What that is new and exciting do Fuller and Steuart tell us of Confederate small arms? In the experience of the reviewer, almost any information under that caption falls into this category. The average collector, even of advanced standing, knows that:

1. The Confederacy seized during the spring of 1861 all U. S. weapons and other ordnance stores housed in Federal arsenals within its borders.
2. At Harpers Ferry, it acquired considerable machinery for the manufacture of small arms. This was sent to Richmond and elsewhere.
3. From components captured at Harpers Ferry and cannibalized from battlefield spoils, a great many small arms of varying types were produced.
4. Factories for arms manufacture were set up by the Confederate and state governments and by private persons at many points throughout the South. Their output was small and when threatened by the near approach of Federal forces it was often necessary to move them bodily to points of greater security.
5. The Confederacy's stock of small arms with which it entered the war was later augmented by battlefield trophies, adaptation of sporting arms to military purposes, and imports from England and Continental Europe.

Beyond this, most collectors are practically uninformed with respect to Confederate hand and shoulder weapons.

ANNOUNCEMENT of the impending publication of this volume brought the reviewer a real anticipatory thrill. What better combination of authors could be asked, with accuracy to one ten-thousandth of a comma guaranteed by Fuller, the engineer, and style by Steuart, the professional man of letters? Each would be a check upon the other; the result, perfection. To make assurance doubly sure, had not one of the twain—Fuller—already produced two substantial volumes on American small arms?

Alas and alack! The book before us is a masterpiece of poor typography, careless compilation, and slipshod exposition. Part I, constituting the section on shoulder arms, and presumably at-

[3] Newburgh, N. Y., 1882.

tributable to Mr. Fuller, is particularly replete with errors of every type and description. These include crude misspellings, misstatements of fact, poor punctuation, transpositions, confused footnotes, bad paragraphing and pagination; in short, about all the ills a book can be heir to.

Despite the manifest importance of so doing in a work of this nature, no consistent effort is made throughout the 231 pages of Part I to identify people, places, or events mentioned. Accounts of the same affair are narrated two, three, and four times. Documents, sometimes of considerable length are printed, and needlessly reprinted. From some, deletions have been made. But instead of doing this carefully, so that the flow of thought will pass evenly across the hiatuses, the text has, in almost every instance, been guillotined in such crude fashion as to make it impossible to reconcile the purport of succeeding sentences. And, incredible as it may seem, Mr. Fuller, despite a lifetime devoted to the study of American arms and arms makers, cannot yet spell correctly the names of two of the foremost among the latter—Christian Sharps and Henry Deringer. Indeed the commonly accepted rules of grammar, punctuation, and spelling—*e.g.*, "sight" for "site," meaning "location"—appear to be without standing in his eyes. And he indulges in an orgy of capitalizing any and every noun that strikes his fancy; *e.g.*, "Eye-Bolt," "Autumn," "Ratchett" (*sic*) to a degree which leads us to suspect that pure Nordic gametes must certainly predominate in his heredity.

Footnotes, like punctuation marks, appear to have been grabbed by the handful and thrown blindly at the passing pages. At times the latter are wholly without orderly numerical sequence. Thus note No. 1, Chapter 4, appears at the bottom of p. 156, with No. 2 on p. 158. Missing thereafter are Nos. 3 to 19, inclusive. On p. 164 we meet No. 20. The sequence then proceeds without break to No. 30 (p. 168). The note next succeeding (p. 175) is the long-lost No. 3. Thereafter the rest of the missing numbers are gradually fed into the text, sometimes in proper rotation, sometimes badly jumbled. The last (No. 19) is found on p. 192.

Unfortunately, such documentation as does appear in footnote form (and much that should so appear does not) is sloppily executed. Initials of authors, dates, and places of publication are commonly lacking, as are references to page numbers, even when the inclusion of these is definitely indicated. The "Official Records of the War of the Rebellion" are accorded four different designations, thus: "Official Records, War of the Rebellion" (p. 156); "Official Records" (p. 164); "Rebellion Records" (p. 166); "Official Record, War of the Rebellion" (p. 233). Nowhere is there evidence of the least desire to make it easy for the serious reader to identify, or to locate, the source quoted.

SOME errors of fact were noted. Thus Fuller describes (p. 74) a Hall flintlock "carbine." None such were made. Apparently he has misled himself because of a confusion of captions in the text and the plate (No. VII) accompanying. Similar confusion exists with respect to "Cook" carbines and musketoons (p. 149 and Plate XIV). Again he states that Sir Joseph Whitworth's experiments with cannon of polygonal bore *preceded* his development of small arms of similar characteristics. This is incorrect.[4] He likewise describes the quickest rifling developed by Whitworth as having one turn in *five* inches, whereas Sir Joseph himself records developing a bore with a twist of one turn in *one* inch![5] Certain of his figures on Civil War arms production are palpably erroneous. Thus he states (p. 241) that to June 30, 1862, the Federal Government had bought 10,640 Remington revolvers. But three pages later we learn that it purchased only 5,000 revolvers of that make, calibers .36 and .44, throughout the entire war. As a matter of fact, the number

[4] Whitworth, J., "Guns and Steel," London, 1877, p. 19.
[5] *Ibid.*, p. 23.

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Book Reviews

it acquired over this period from the makers alone, exclusive of those secured from dealers, was almost 128,000.[6]

Coming to Part II of this work (Pistols and Revolvers), Mr. Steuart's contribution, we meet a happier situation, though even he spells the name of a certain arms manufactory two different ways on p. 247. Like Fuller, his footnotes are too often inadequately documented, and like him too, his unnecessary use of capitals suggest a secret link with the hackenkreuz. He also invents a new caliber of pin-fire revolver (11-mm.) whereas it is common knowledge that the calibers in which these were produced were limited to 5, 7, 9, 12, and 15-mm. But in general his work is well executed. Nevertheless, as the literary member of the firm, Steuart must bear the onus for the lack of a bibliography and the hopeless inadequacy of the subject index.

In answer to the first of these indictments it may be claimed that the bibliography is to be found in the footnotes. As to the quality of these, we have already made definite expression. But in the matter of the subject index, no plea can be accepted. For it is so incomplete that the work would have improved, rather than suffered, by its total omission.

But, despite these failings, Fuller and Steuart have now thrown wide the doors to vast storehouses of information on each and every one of the subjects enumerated. Names, dates, and places of manufacture, with costs and production statistics, are supplied for scores of varieties of Confederate rifles, pistols, carbines, revolvers, muskets, and musketoons. Recorded are the names of those who produced these weapons, the difficulties under which they labored, and the successes they achieved. The assembly of these data must have been a stupendous task. One wonders how it was ever brought to completion.

Not only are Fuller and Steuart without competition; there is little chance of the appearance hereafter of other works on Confederate small arms. The hour is already too late. Wherefore, ye who thirst after knowledge of these weapons, clasp this volume to your bosoms and give thanks for its existence, since it is more than probable that within its confines will be found pretty nearly everything that ever will be recorded concerning the firearms of the Confederacy.—C. G.

Books Received

HAND CANNON TO AUTOMATIC. By Herschel C. Logan. Huntington: Standard Publications, Inc. 172 pp.

BOTTS IN WAR, BOTTS IN PEACE. By William Hazlett Upson. New York: Farrar & Rinehart, Inc. 327 pp.

MILITARY JUSTICE FOR THE FIELD SOLDIER. By Lieut. Col. F. B. Wiener. Washington: *The Infantry Journal.* 152 pp. $1.

WAR THROUGH THE AGES. By Lynn Montross. New York: Harper & Brothers. 941 pp. $5.

WRITTEN IN SAND. By Josephine Young Case. Boston: Houghton Mifflin Company. 161 pp. $2.

THE CHINESE LABOR MOVEMENT. By Nym Wales. New York: The John Day Company, Inc. 235 pp. $2.75.

THE VIGIL OF A NATION. By Lin Yutang. New York: The John Day Company, Inc. 262 pp. $2.75.

WINGED PEACE. By Air Marshal William A. Bishop, VC, RCAF. New York: The Viking Press. $2.75.

RAILROADS AT WAR. By S. Kip Farrington, Jr. New York: Coward-McCann, Inc. 320 pp. $4.

ARGENTINE RIDDLE. By Felix J. Weil. New York: The John Day Company, Inc. 297 pp. $3.50.

EUROPE—AN ATLAS OF HUMAN GEOGRAPHY. By Marthe Rajchman. New York: William Morrow & Company. 120 pp. $2.

THE WILD BLUE YONDER. By Emile Gauvreau. New York: E. P. Dutton & Company. 369 pp. $3.

RUSSIA—THEN AND ALWAYS. Nina Verhovsky Hyde and Fillmore Hyde. New York: Coward-McCann, Inc. 331 pp. $3.

[6] Ex. Doc. No. 99, H. of R., 40th Congress, Second Session, Washington, D. C., 1868.